The Engineer.

Established 1856. Registered as a Newspaper.

OFFICE FOR ADVERTISEMENTS & PUBLICATION, 28, ESSEX ST., STRAND, LONDON, W.C. 2.

VOL. CLII.—No. 3939] LONDON: FRIDAY EVENING, JULY 10, 1931 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE.
ARRANGED FOR CARD INDEXING.

The R.A.S.E. Show at Warwick. (P. 31)
THE ENGINEER, 10 - 7 - 31.

The Institution of Naval Architects at Paris No. II. (P. 29)
THE ENGINEER, 10 - 7 - 31.

A New Form of Grit Catcher. (P. 45)
THE ENGINEER, 10 - 7 - 31.

A New Stoker. (P. 46)
THE ENGINEER, 10 - 7 - 31.

The Yallourn Lignite Generating Station. (P. 28)
THE ENGINEER, 10 - 7 - 31.

Trade and Foreign Colonies—No. II. (P. 35)
THE ENGINEER, 10 - 7 - 31.

Congress on History of Science and Technology—No. II. (P. 42)
THE ENGINEER, 10 - 7 - 31.

The Design of Large Ships. (P. 46)
THE ENGINEER, 10 - 7 - 31.

INDEX TO ADVERTISEMENTS, PAGE 71.

PUBLIC NOTICES.

Air Ministry.
DIRECTORATE OF TECHNICAL DEVELOPMENT.
TECHNICAL ASSISTANT, Grade III., REQUIRED for calculation and experimental work in connection with Aero-engine investigations. Candidates must have had works and drawing-office experience and technical training to the standard of B.Sc. Degree. Candidates should also be medically fit for flying duties and be willing to fly as observer.
Preference given, other things being equal, to ex-Service men.
Commencing salary £150 plus Civil Service bonus per annum, giving a present total starting remuneration of £215 2s. per annum, on the scale £150-£10-£220 plus bonus.
Apply (quoting reference No. A. 499), stating age and full particulars of training, qualifications and experience, to the CHIEF SUPERINTENDENT, Royal Aircraft Establishment, South Farnborough, Hants. 7220

Department of Scientific and Industrial Research
A JUNIOR ASSISTANT (ENGINEER) is REQUIRED at the Building Research Station, near Watford. Candidates should have a good honours degree or equivalent qualification, together with engineering experience and good mathematical ability. Scale of salary £175-15-£235 plus Civil Service bonus (total at present rates £246-£319). There are prospects of promotion to higher grades. Superannuation provision is made under the Federated Superannuation System for Universities.
Application must be made on a form to be obtained from the SECRETARY, Department of Scientific and Industrial Research, 16, Old Queen-street, S.W. 1, to whom it should be returned not later than July 18th, 1931. 7219

Royal Arsenal, Woolwich.
ORDNANCE FACTORIES.
CHEMICAL ENGINEER, preferably F.I.C., REQUIRED as ASSISTANT MANAGER in the ROYAL FILLING FACTORIES. Candidates must be between 30 and 45 years of age. Experience in works management of modern explosive filling factory is desirable. The upper age limit may, if necessary, be extended in case of candidate already serving under the War Department. Salary (to which Civil Service cost-of-living bonus is added) £350, rising by annual increments of £15 to £500 per annum. Bonus on £350 is at present £106 8s. The post will be pensionable, but the candidate selected will be required to serve on probation for a period not exceeding two years before being confirmed in his appointment. Preference will be given to ex-Service candidates. Application to be made with three testimonials not later than the 18th July on form to be obtained from the CHIEF SUPERINTENDENT of the ROYAL ORDNANCE FACTORIES, Woolwich Arsenal, S.E. 18. 7229

Heriot-Watt College, Edinburgh
DEPARTMENTS OF MECHANICAL ENGINEERING AND ELECTRICAL ENGINEERING.
MECHANICAL ENGINEERING:
PROFESSOR A. E. HORNE, O.B.E., B.Sc., M.I. Mech. E., A.M.I.C.E.
ELECTRICAL ENGINEERING:
PROFESSOR F. G. BAILY, M.A., M.I.E.E.
FULL-TIME DAY DIPLOMA COURSES leading to professional recognition.
CLASSES COMMENCE 12th OCTOBER.
Full particulars from the College.
J. CAMERON SMAIL, O.B.E., Principal. 7117

The Royal Technical College, Glasgow.
DEPARTMENTS OF ENGINEERING.
Mechanics and Mechanical Engineering:—
Professor ALEXANDER L. MELLANBY, D.Sc., M.I. Mech. E.;
Associate Professor WILLIAM KERR, Ph.D., A.R.T.C., M.I. Mech. E.
Electrical Engineering:—
Professor STANLEY PARKER SMITH, D.Sc., M.I.E.E., A.M. Inst. C.E.
Civil Engineering:—
Professor GEORGE MONCUR, B.Sc., M. Inst. C.E., M. Amer. Soc. C.E.
Mining Engineering:—
Professor DANIEL BURNS, M. Inst. M.E.
Chemical Engineering:—
Professor of Technical Chemistry: THOMAS GRAY, D.Sc., LL.D., Ph.D., F.I.C.
Complete Courses of instruction are provided, qualifying for the Diploma and Associateship of the College and for the Degree of B.Sc. in Engineering of Glasgow University.
Composition fee, 25 guineas per annum.
SESSION 1931-32 BEGINS on TUESDAY, SEPTEMBER 22nd.
Calendar, by post, 3s., and prospectus, gratis, may be obtained on application to the SECRETARY. 7223

University of Bristol.
FACULTY OF ENGINEERING.
(Provided and Maintained in the MERCHANT VENTURERS' TECHNICAL COLLEGE.)
VICE-CHANCELLOR: T. LOVEDAY, M.A., LL.D.
DEAN OF THE FACULTY: ANDREW ROBERTSON, D.Sc., M.I. Mech. E., M. Inst. C.E.
DEPARTMENTS.
CIVIL ENGINEERING—Prof. A. J. SUTTON PIPPARD, M.B.E., D.Sc., M. Inst. C.E., M.I. Mech. E., F.R.Ae.S.
MECHANICAL ENGINEERING—The DEAN.
ELECTRICAL ENGINEERING — Prof. DAVID ROBERTSON, D.Sc., M.I.E.E.
AUTOMOBILE ENGINEERING—Prof. W. MORGAN, B.Sc., M.I.A.E.
MATHEMATICS—Prof. E. S. BOULTON, M.A., B.Sc.
GEOLOGY—Prof. S. H. REYNOLDS, M.A., Sc.D.
CHEMISTRY—Prof. F. FRANCIS, D.Sc., Ph.D., F.I.C.
Full particulars of Courses and of the University Halls of Residence may be obtained on application to the REGISTRAR, M.V.T. College, Bristol.
The SESSION 1931-32 COMMENCES on OCTOBER 2nd. 7226

The Manchester Steam Users' Association.
For the Prevention of Steam Boiler Explosions and for the Attainment of Economy in the Application of Steam. 20, QUAY-STREET, DEANSGATE, MANCHESTER.
Founded 1854 by SIR WILLIAM FAIRBAIRN.
Certificates of Safety issued under the Factory and Workshops Act, 1901. Compensation for Damages and Liabilities paid in case of Explosions. Engines and Boilers Inspected during construction. 6762

University College of Swansea.
(A CONSTITUENT COLLEGE OF THE UNIVERSITY OF WALES).
Principal: C. A. EDWARDS, D.Sc., F.R.S.
APPLIED SCIENCE DEPARTMENTS.
ENGINEERING.
Professor: FREDERIC BACON, M.A. (Cantab.), A.M. Inst. C.E., M.I. Mech. E., M.I.E.E.
Lecturer in Electrical Engineering: R. G. ISAACS, M.Sc. (Bristol), B.Sc. (Lond.), A.M.I.E.E.
Lecturer in Civil Engineering: A. A. FORDHAM, B.Sc. (Lond.), A.M. Inst. C.E., M.I. Struct. E.
Assistant Lecturer: J. SELWYN CASWELL, M.Sc. (Wales), A.M.I. Mech. E.
METALLURGY.
Professor: C. A. EDWARDS, D.Sc. (Manchester), F.R.S.
Assistant Professor: L. TAVERNER, A.R.S.M.
Lecturer: R. HIGGINS, Ph.D. (Glasgow).
Assistant Lecturers: R. GRIFFITHS, M.Sc. (Wales), A. E. W. SMITH, Ph.D. (Birmingham).
The College offers a number of exceptional advantages to Students who aim at entering upon professional careers in Engineering or in Metallurgy. It is situated in the heart of an industrial area which includes a large number of works of very varied character, and presents an unrivalled variety of metallurgical practice. The Manufacturers of the district, who contribute largely to the support of the College, give the Staff and Students of the Applied Science Departments every access to the Works, and the Managers, Engineers, and Technical Officials co-operate with the Staff of the College in making visits to Works of practical educational value to the Students.
Courses of study are provided (1) for the B.Sc. Degree of the University of Wales in (A) Civil Engineering, (B) Mechanical Engineering, (C) Electrical Engineering, (D) Metallurgy; and (2) for Diplomas of the College in (A) Civil Engineering, (B) Mechanical Engineering, (C) Electrical Engineering, (D) Metallurgy.
Persons who are not desirous of studying for Degrees or Diplomas may attend selected College Classes, provided they satisfy the authorities of the College that they are qualified to benefit by such classes.
Entrance Scholarships will be offered for competition in April, 1932.
Particulars concerning admission to the College, and of the Entrance Scholarships, may be obtained from the undersigned.
EDWIN DREW,
Registrar.
Singleton Park, Swansea. 7224

PUBLIC NOTICES.

University of Liverpool.
FACULTY OF ENGINEERING.
DEAN: Professor G. E. SCHOLES, M.B.E., M.Sc., M.I.A.E., M.I. Mech. E.
The University awards the Degrees of B.Eng., M.Eng., D.Eng., Ph.D., and a Certificate and Diploma in Engineering.
Degree candidates must pass an approved Matriculation Examination. Certificate candidates must submit evidence of having received a good general education. Diploma candidates must possess the Certificate in Engineering.
The Courses are designed for students desiring to qualify as MECHANICAL, ELECTRICAL, CIVIL, or MARINE ENGINEERS, as NAVAL ARCHITECTS and METALLURGISTS or METALLURGICAL ENGINEERS. The Courses cover the subjects of examination for Associate Membership of the Institutions of Civil, Mechanical and Electrical Engineers. The Institutions named, subject to certain conditions, accept the Degree of B.Eng. in lieu of part, and in some cases the whole, of the examinations for Associate Membership. The various Departments are housed in commodious and well-equipped buildings, and provide ample facilities for research.
A prospectus of the Faculty, giving particulars of Courses and a large number of Entrance and Post-graduate Scholarships, may be had on application to the undersigned.
EDWARD CAREY,
6797 Registrar.

Trinity House, London.
TO BUILDERS AND CONTRACTORS.
The Corporation of Trinity House invite TENDERS for the RENEWAL of FENDER PILES and REPAIRS to the QUAY WALL at Trinity Wharf, East Cowes, Isle of Wight.
Forms of Tender, specifications, and drawings can be obtained upon the payment of a deposit of £1 (to be refunded on receipt of a bona fide Tender and the return of all the drawings and documents furnished) on application to the Secretary, Trinity House, Tower-hill, London, E.C. 3, to whom Tenders are to be delivered not later than 10 a.m. on Thursday, 30th July, 1931, in sealed envelopes, marked outside "Tender for Renewal of Fender Piles, &c., at East Cowes Depot."
The Corporation of Trinity House do not bind themselves to accept the lowest or any Tender.
M. K. SMITH,
Secretary.
July 1, 1931. 7221

PUBLIC NOTICES.

PATENTS AND DESIGNS ACTS, 1907 TO 1928.
Notice is Hereby Given that WALTER KIDDE and CO., INC., of 140, Cedar-street, New York, United States of America, SEEK LEAVE to AMEND the SPECIFICATION of LETTERS PATENT No. 296,404 granted to them for an invention entitled "Improvements relating to Fire Extinguishing Apparatus."
Particulars of the proposed Amendment were set forth in No. 2215 of the Illustrated Official Journal (Patents) published on the 1st July, 1931.
Any person, or persons, may give Notice of Opposition to the Amendment by leaving Patents Form No. 19 at the Patent Office, 25, Southampton-buildings, London, W.C. 2, within one calendar month from the date of publication of the said Journal.
W. S. JARRATT,
7217 Comptroller-General.

Administrative County of London.
WESTMINSTER BRIDGE-ROAD—PEDESTRIAN SUBWAY.
The London County Council invites TENDERS for the CONSTRUCTION of a PEDESTRIAN SUBWAY under Westminster Bridge-road between the County Hall and St. Thomas's Hospital. Proper facilities for tramway, vehicular and pedestrian traffic must be maintained during the progress of the work.
The specification, form of Tender, &c., may be obtained on and after Monday, 13th July, 1931, on application to the Chief Engineer, The Old County Hall, Spring-gardens, S.W. 1, upon payment of £2 by cheque, draft or money order to the order of the London County Council. This amount will be returnable only if the tenderer shall have sent in a bona fide Tender and shall not have withdrawn the same. Full particulars of the work may be obtained on personal application and the contract documents may be inspected before payment of the fee.
Remittances by post should be addressed to the Chief Engineer, The Old County Hall, Spring-gardens, S.W. 1. Personal Inquiries at Room 2, No. 3, Warwick House-street, Cockspur-street, S.W. 1.
The contractor will be bound to observe the provisions of a fair wages clause, the terms of which are set out fully in the instructions for Tender and form of contract and in "The London County Council Gazette."
No Tender received by the Clerk of the Council at the County Hall, Westminster Bridge, S.E. 1, after 4 p.m. on Tuesday, 4th August, 1931, will be considered.
The Council does not bind itself to accept the lowest or any Tender.
MONTAGU H. COX,
7230 Clerk of the London County Council.

The Chinese Government Purchasing Commission.
The Commission are prepared to receive TENDERS from British Manufacturers for:—
15 MILES LIGHT RAILS (14 lb. per yard), STEEL SLEEPERS, FASTENINGS and SWITCHES.
Tender forms, general conditions and specifications can be obtained at the Offices of the Consulting Engineers,
Messrs. Sandberg,
40, Grosvenor-gardens, London, S.W. 1.
A fee of Five Shillings, which is not returnable, will be charged for each set.
The Commission do not bind themselves to accept the lowest or any Tender, and reserve the right to divide and/or reduce the order.
Tenders, on the official forms, enclosed in sealed envelopes, marked "Tender for Light Rails," and addressed to
The Chairman,
Chinese Government Purchasing Commission,
21, Tothill-street, Westminster, London, S.W. 1,
must be submitted before Noon on Wednesday, the 22nd July, 1931.
7231 BY ORDER OF THE COMMISSION.

City of Norwich.
STRUCTURAL AND MECHANICAL ENGINEER-DRAUGHTSMAN.
APPLICATIONS are INVITED for the APPOINTMENT of a STRUCTURAL and MECHANICAL ENGINEER DRAUGHTSMAN in my Department. Must have had sound practical and designing experience in general mechanical engineering, structural steel work for buildings and bridges of steel and reinforced concrete; preferably with experience as draughtsman on the maintenance and extensions staff of a large manufacturing concern. Must be thoroughly reliable and capable of making calculations and designs. Preference will be given to candidates who have qualified for membership of the Institution of Civil Engineers or possess a similar qualification.
The Local Government and Other Officers' Superannuation Act, 1922, has been adopted by the Council, and the appointment will be subject thereto. The selected candidate will be required to pass a medical examination.
The salary will be in accordance with Class 6 of the Council's Scale of Salaries, viz., £305 per annum, rising by annual increments to £365 per annum.
The appointment will be subject to one month's notice to be given by, or served on, the Town Clerk.
Applications, stating age, qualifications, present appointment and experience, together with copies of three recent testimonials, to be sent to the undersigned, endorsed "Mechanical Engineer," not later than 10 a.m. on Monday, 20th July, 1931.
Canvassing, either directly or indirectly, will disqualify.
J. S. BULLOUGH, M. Inst. C.E.,
City Engineer.
Guildhall, Norwich.
1st July, 1931. 7222

PUBLIC NOTICES (continued) Page 2.
SITUATIONS OPEN, Page 2.
SITUATIONS WANTED, Page 2.
AUCTIONS, Page 72.
PARTNERSHIPS, Page 2.
MACHINERY, &c., WANTED, Page 72.
PATENTS, Page 4.
MISCELLANEOUS, Page 2.
AGENCIES, Page 4.
FOR HIRE, Page 72.
EDUCATIONAL, Page 2.
BUSINESSES and PREMISES (For Sale, etc.), Page 72.
FOR SALE, Pages 4 and 72.
WORK WANTED, Page 72.

For Advertisement Rates see Leader Page.

PUBLIC NOTICES.

City of Liverpool.

CITY ABATTOIR, MEAT, AND CATTLE MARKETS, STANLEY.

The Markets Committee of the City Council invite APPLICATIONS for the following POSITIONS at the above, viz.:—

Position.	Salary.
General Engineer	£400 per annum.
Refrigeration Engineer	£300 per annum.
Electrical Engineer	£300 per annum.
Superintendent of Cold Storage	£350 per annum.

The duties of the several engineers will comprise the full control of, and responsibility for, all apparatus and equipment in their respective departments, and the performance of any other similar duties which may be allotted to the respective positions.

The duties of the Superintendent of Cold Storage will comprise the full control of, and responsibility for, all arrangements for storage of articles placed in the Cold Stores and the performance of any similar duties which may be allotted to the position.

The persons appointed will be subject to the provisions of the Local Government and Other Officers' Superannuation Act, 1922 (Substituted Scheme), and the Standing Orders of the Council.

Applications, stating age, experience, and qualifications, together with copies of not more than three testimonials, to be sent to the Town Clerk, Municipal Buildings, Dale-street, Liverpool, on or before the 15th day of July, 1931.

ENVELOPES CONTAINING APPLICATIONS MUST BE ENDORSED WITH THE TITLE OF THE POSITION APPLIED FOR.

Canvassing of members of the Council will be regarded as a disqualification.

WALTER MOON,
Town Clerk.

Town Clerk's Office, Liverpool,
3rd July, 1931. 7225

SITUATIONS OPEN.

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

TO ADVERTISERS UNDER BOX NUMBERS IN THIS CLASSIFICATION.

For the benefit of applicants, the Proprietors are prepared to insert brief notices that vacancies are filled, upon receipt of notifications from the Advertisers. These notices (limited to one line) will be free of charge and co-operation is asked for.

WANTED, First-class DESIGNER, with Experience in Application of Hydraulic Drives and Feeds to Machine Tools. State experience and salary required.—Address, 7242, The Engineer Office. 7242 A

COX AND DANKS, LTD., Iron and Steel Merchants, 168, Regent-street, London, W. 1, have VACANCY in their London office for a smart ASSISTANT with experience of Scrap Trade.
Write, giving full particulars of experience, stating age and salary required. 7243 A

ENGINEER, Experienced (Shop-trained), WANTED for SENIOR POSITION in ENGINEERING SECTION of BRITISH MERCHANT'S BUSINESS in MALAYA. Must be first-class Sales Organiser, and have had thorough training in up-to-date business methods. Plenty of drive and able to hold and expand the business essential. Four years' contract; first-class passage paid.
Write, with full particulars of education, qualifications, and experience, age, whether married, &c., to "B. A.," 64, Cannon-street, E.C. 4. P1314 A

GENERAL MANAGER REQUIRED for Large Works manufacturing highest grades of Steel, with a present output of Ingots of about 100,000 tons per annum.
Write, giving full particulars of experience to P1312, The Engineer Office. P1312 A

LARGE ENGINEERING GROUP DESIRE to APPOINT MANAGER of PUBLICITY DEPARTMENT. Applicants must have had good general experience of similar work and be conversant with both Press Advertising and Compilation of Catalogues and Sales' Literature.
Address, stating salary required, P1294, The Engineer Office. P1294 A

MALE STENOGRAPHER WANTED for Engineering Dept. of Factory situated at Brentford. Only those with previous experience in an engineering office need apply. State age, experience and salary required.—Address, 7202, The Engineer Office. 7202 A

THERE is a VACANCY for a SALES EXECUTIVE on the Staff of an Engineering Firm in the South of England. Practical experience essential. State salary required and age.—Address, 7234, The Engineer Office. 7234 A

WANTED, DRAUGHTSMAN, Experienced in the design and detail of Conveying and Elevating Plant and Light Steel Structures. State age, experience, and salary required.—Address, 7248, The Engineer Office. 7248 A

DRAUGHTSMAN (MECHANICAL) WANTED for works 25 miles out of London.
Only keen, live men, able to work on own initiative and with proved experience of modern production methods need apply.
State concise details of experience, age, and salary expected.
Address, 7241, The Engineer Office. 7241 A

SITUATIONS WANTED.

AN ENGINEER, Age 28, DESIRES CHANGE, Any capacity with prospects. G.I. Mech. E., Higher National, &c.; experience, mechanical, chemical, structural, electrical, works, D.O., and commercial.—Address, P1296, The Engineer Office. P1296 B

A.M.I. MECH. E. (29), D.O. and Works Trained, struct., mech., gen. engineering, ex. ref., home and abroad, as erecting, supervising sales engineer, REQUIRES PROGRESSIVE POST.—Address, P1302, The Engineer Office. P1302 B

BRAZIL: MANAGER OR REPRESENTATIVE.—CHARTERED CIVIL ENGINEER with 24 years' residence in Brazil as Railway General Manager and Chief Construction Engineer, and having exact, detailed and up-to-date knowledge of prevailing conditions in Brazil, is OPEN to CONSIDER APPOINTMENT.
Address, P1299, The Engineer Office. P1299 B

CHEMICAL ENGINEER, 32, Single, DESIROUS of REPRESENTING FIRM on Solvent Recovery Installations. Ex. ref. Home and abroad as Erecting Supervising Engineer, Plant Layout, General Engineering.—Address, P1276, The Engineer Office. P1276 B

MECH., CONSTRUCTIONAL and RAILWAY ENGINEER SEEKS POST, design, works, commercial, positions held, good organiser; home or abroad; age 44, speaks Spanish.—Address, P1253, The Engineer Office. P1253 B

MECH. ENGINEER (26 Yrs.) REQUIRES POST. 4 years' sea, turbine, superheating, oil fuel, &c., drawing-office experience; technical training.—Address, P1313, The Engineer Office. P1313 B

MECHANICAL ENGINEER (28), 13 Years' Technical and practical experience, including experimental work, SEEKS SITUATION with chance for ability and initiative. Experience abroad, knowledge German and French.—Address, P1307, The Engineer Office. P1307 B

DRAUGHTSMAN, Constructional (24), 8½ Years' D.O. exp., steel-framed buildings, designing, estimating and detailing, excellent refs., would travel, disengaged.—Address, P1298, The Engineer Office. P1298 B

VALUATIONS

ARE

A PROFITABLE INVESTMENT

Balance Sheets, showing the **Values** of the Company's **Land, Buildings, Plant, Machinery and Equipment Certified by Independent and Unbiassed Experts of acknowledged standing** at once relieve the Directors of an unnecessary and undesirable responsibility and show them exactly how they stand.

* * * * *

Such a Certificate of Value is welcomed by, and is of considerable value to, the Company's Accountants and creates that feeling of confidence and satisfaction among the investors so essential.

* * * * *

It enables you to secure, at short notice, **Financial Assistance** either from your Bankers, private or public sources.

* * * * *

When negotiating for an amalgamation with one or more other Concerns, or for a sale outright of your business, the possession of the Valuer's Certificate places you in the most favourable position for the discussion of terms.

* * * * *

In dealing with every-day matters, such as Allowances for Depreciation, Rate Assessment, Fire Insurance, etc., the Valuer's Certificate readily solves your problems.

* * * * *

Whilst, therefore, a Valuation may be made for a specific object, the same Valuation may be made to serve so many other useful purposes that the cost (which varies according to requirements) does, in fact, represent a profitable outlay.

* * * * *

For over **80 Years** we have specialised in this work, and may, we think, claim to occupy a position of some eminence, and the cumulative experience gained, which has been so helpful to hundreds of our clients, will be gladly placed at your disposal.

* * * * *

As a friendly and informal discussion would be the means of placing you in possession of many facts calculated to be of real assistance to you, we venture to hope you will permit us (entirely without obligation) to visit you.

WHEATLEY KIRK, PRICE & Co.

(ESTB. 1850)

SPECIALISTS IN

VALUATIONS OF ENGINEERING AND MANUFACTURING WORKS PROPERTIES,

46, WATLING STREET, LONDON, E.C. 4.

SITUATIONS WANTED (continued).

DRAUGHTSMAN-DESIGNER, Rapid Detailer, steam and petrol vehicles, cars, trailers, home or abroad, DESIRES IMMEDIATE POSITION.—Address, P1315, The Engineer Office. P1315 B

DRAUGHTSMAN (29), London, 3 Years Tech. college, 5 years shops, 8 years D.O., centl. and recipg. pumps, gears and general experience; excellent refs.—Address, P1309, The Engineer Office. P1309 B

MECHANICAL, STRUCTURAL and LAY-OUT DRAUGHTSMAN SEEKS suitable POSITION. Age 30, connections with railway and automobile vehicle, hand cranes and plant equipment, works experience and technical.—Write, Box 526, Sells, Fleet-street, E.C. 4. 7244 B

PARTNERSHIPS.

A PRACTICAL GENTLEMAN REQUIRED with capital by manufacturing concern.—Address, P1297, The Engineer Office. P1297 C

CONSULTING ENGINEERS. — MECHANICAL ENGINEER, A.M.I. Mech. E. (44), with extensive technical and commercial experience with steam turbines, compressors, pumps, fans, &c., DESIRES APPOINTMENT with well-established firm of London Consultants, view to partnership; fluent German, also French.—Address, P1310, The Engineer Office. P1310 C

EXCELLENT POSITION as REPRESENTATIVE is OFFERED to an energetic man who would invest up to £500 in shares in business which will be secured. Good salary, expenses and commission and also car provided.—Address, 7247, The Engineer Office. 7247 C

IN North Midlands a PARTNERSHIP POST WANTED in small Electrical and General Engineering Workshop. Invest £200.—Apply, T. ROPER and CO., Bromsgrove. P1303 C

TO a GENTLEMAN with Capital £2000 to Invest at good interest, upon the security of freehold deeds of property, the POSITION of REPRESENTATIVE is OFFERED at a good salary, expenses and commission, to SELL ENGINEERING and ELECTRICAL SPECIALITIES.
Address, giving full particulars, 7246, The Engineer Office. 7246 C

EDUCATIONAL.

Correspondence Courses

OF PREPARATION FOR THE

Examinations

OF THE
INST. OF CIVIL ENGINEERS,
INST. OF MECHANICAL ENGRS.
INST. OF STRUCTURAL ENGRS,
UNIVERSITY OF LONDON, &c.

ARE PERSONALLY CONDUCTED BY

Mr. Trevor W. Phillips,

B.Sc., Honours, Engineering, London University, Assoc. M. Inst. C.E., A.M.I. Struct. E., M.R.S.I., F.R.S.A., Chartered Civil Engineer, &c.

For full particulars and advice apply to:—
36, DALE STREET, LIVERPOOL.
LONDON OFFICE:—65, CHANCERY LANE, W.C. 2.

Oxford Correspondence College,

BEAUMONT HOUSE, OXFORD.
THOROUGH POSTAL PREPARATION FOR:—
B.Sc. (ENGINEERING), Pass and Honours.
A.M.I.C.E.,
A.M.I.M.E.,
and also Electrical, Structural, Aeronautical, Automobile and Marine Engineering Examinations.
Low fees—payable monthly. 50 Tutors, Individual Attention. Textbooks loaned.
Prospectus from the Secretary.

SURVEYING AND LEVELLING. — EXCELLENT OPPORTUNITY to ACQUIRE thorough Practical INSTRUCTION.—Address, E. MOUL, Hollybank, Woking. P1301 B

T.I.G.B.
CORRESPONDENCE COURSES
FOR THE
PROFESSIONAL EXAMINATIONS

A.M. Inst. C.E., A.M.I. Mech. E., A.M.I.E.E., etc.

Convincing proof that The T.I.G.B. training is markedly successful is found in the many pages of "The Engineer's Guide to Success" which are filled with typical results of T.I.G.B. Students. This testimony of former Students obviously provides the soundest reason why you too may enrol with The T.I.G.B. with every confidence in the issue

Write to-day for "The Engineer's Guide to Success" — 128 pages — containing the widest selection of engineering courses in the world, and mention the branch, post or qualification that interests you. The T.I.G.B. guarantees training until successful for the one fee.

THE TECHNOLOGICAL INSTITUTE OF GREAT BRITAIN,
76, Temple Bar House, London, E.C. 4
(Founded 1917.)

MISCELLANEOUS.

WANTED, ENGINEERING FIRM to TAKE UP the MANUFACTURE and SALE of the BAILLIE ELECTRIC ROAD BREAKER, COAL and ROCK HEADING MACHINE and CONVEYOR. Can be seen working.—Address, P1308, The Engineer Office. P1308 I

AMERICAN ENGINEERS, MANUFACTURERS, FINANCIERS, &c., Visiting Europe, are INVITED to INSPECT near London WORKING DEMONSTRATION GAS DISPLACEMENT PUMP, the cheapest means of applying natural gas to irrigation, land drainage, &c., ever offered. Capital required for U.S. development.—Address, P1300, The Engineer Office. P1300 I

ENGINEERS.

ARE YOU EARNING LESS THAN £10 PER WEEK? If so, you cannot afford to carry on without reading "ENGINEERING OPPORTUNITIES." This 200-page book is filled with matters of vital importance to you. Among other things, it explains the methods of our unique Appointments Department, gives details of all leading Eng. Exams. (A.I. Mech. E., A.M.I.E.E., B.Sc., G.P.O., &c.), and outlines modern Courses in Civil Mech., Elec., Motor, Aero., Radio, Talkie and all other branches of Engineering. This book will alter your entire outlook and earning power. It is quite FREE. Send a P.C. for your copy, NOW.

BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY,
22, Shakespeare House, 29-31, Oxford St., London.
P1290 I

For Continuation of Small Advertisements see Page 4.

A Seven-Day Journal

The Kirkstall Power Station.

ON Monday, July 6th, the Earl of Harewood opened the new Kirkstall power station, which has been built at a cost of £800,000. The decision empowering the Leeds Corporation to proceed with the construction of this station was issued by the Electricity Commissioners in April, 1927, and the work of designing the station and issuing the necessary specifications was begun in the early part of 1928. At present, the generating plant consists of two B.T.H. turbo-generator sets, each having a continuous output of 25,000 kilowatts, or 35,714 kilovolt-ampères at 0·7 power factor. There are three Stirling tri-drum boilers, designed for a working pressure of 475 lb. per square inch, and each is capable of evaporating 160,000 lb. of water per hour under normal working conditions, or 184,000 lb. on overload. For the equipment of the boiler-house, which includes a pulverised coal plant, the International Combustion Company, Ltd., was responsible. Each boiler is equipped with an economiser, and an air heater of the Ljüngstrom type, and the steam is superheated to 750 deg. Fah. For handling the ashes a Hydrojet plant made by the Ash Company (London) Ltd. has been installed. Primary and secondary air fans of the usual Sirocco construction and Davidson dust collectors are provided for each boiler. The condensing and feed heating plant was supplied by W. H. Allen, Sons and Co., Ltd., whilst Ferguson Pailin, Ltd., supplied the main switchgear.

Trade with the Argentine.

ACCORDING to a communication from the Federation of British Industries, the first meeting of the newly constituted Argentine Committee, which has been formed to follow up the results of the Buenos Aires Exhibition, was held recently. After passing a resolution thanking H.R.H. the Prince of Wales for the great services he rendered to British industry during his recent tour in S. America, the Committee decided upon the following future programme:—(*a*) The appointment of a small executive committee of five members, whose duty it will be to study the various problems arising and to initiate suggestions for the development of British trade with Argentina for consideration by the main Argentine Committee. (*b*) It was decided to work in the closest possible touch with the Department of Overseas Trade and the British Chamber of Commerce in Buenos Aires in formulating these plans for trade development. (*c*) One of the main functions of the Committee will be to ensure the maximum amount of co-operation between British interests in tackling the Argentine market, both from the point of view of the representation of general trade interests, the creation of joint selling organisations, and the general question of publicity and trade propaganda. (*d*) It was decided to take steps to form an Argentine Group of the Federation, composed of those associations and firms which are more particularly interested in the Argentine market, in order that the Committee may be in a position to have really powerful industrial support for any suggestions for action which they may put forward.

The Charing Cross Bridge.

IN a Journal note of March 6th this year, and an article on March 20th, we recorded the decisions of the Charing Cross Bridge Advisory Committee, which was constituted to examine schemes for the construction of a road bridge and approaches at Charing Cross and to put forward an agreed conclusion. Unfortunately, the Committee was unable to come to a unanimous decision. The matter has now been carried a stage further by the decision reached on Tuesday by the London County Council to reconstitute the Committee for further examination of the proposals upon which scheme No. 4 was based. Sir William Ray, moving the resolution, pointed out that a document had been circulated to Members of the Council by a firm of engineers, and that letters supporting the statements made in that document had appeared in the Press. General approval had been expressed of the Council's action in setting up the Advisory Committee after the rejection of the Bill by the Select Committee of the House of Commons last year. The Council had been very patient, and he was going to ask it to extend its record of patience for a week or two. The action of the firm of engineers made it necessary to postpone a decision. After expressing the gratitude of the Council to Sir Leslie Scott, he moved that the Advisory Committee should be reconstituted as mentioned above. Sir Percy Simmons, who seconded the motion, said that they were all anxious that there should be as little delay as possible in coming to a final decision. According to present arrangements the firm of engineers referred to would be heard by the Committee on Thursday. The decision of the Council appears to have been brought about by the consideration that scheme No. 6, to which the Advisory Committee gave a hesitating approval, appears only to be a modification of the scheme rejected by the Select Committee of the House of Commons, while doubts have been expressed as to whether scheme No. 4 received the consideration that it deserved. According to the latter scheme, which was submitted by Sir Murdoch MacDonald and others, there would be a low-level station on the Lion Brewery site, thus avoiding the objectionable bridging-over contained in scheme No. 6.

Persian Orders for Sweden.

A SWEDISH-PERSIAN contract, which has just been signed after three months of careful preparation, is stated to be the first step in a series of very large business transactions between the two countries, involving an expenditure of possibly more than 5 million pounds sterling. The Persian Government has begun the construction of a railway line between the Caspian Sea and the Gulf of Persia, crossing the whole country and passing through Teheran. About a fifth of the distance has been finished by German and American firms. Persia now wishes to complete the enterprise by herself. A delegation, headed by his Excellency Arbab K. Shahrekh, has spent three months in Sweden preparing the closing of one of the largest business deals in recent years in that country. Eleven industrial firms will deliver to Persia, in accordance with ninety special contracts, goods and materials over a period of about five years. The two contracting parties will open mutual credit accounts in their respective countries, and a large clearing company, headed by the Swedish Co-operative Union, will be formed in Sweden to purchase Persian goods in exchange for goods and materials delivered to Persia. The Persian commodities will then be resold in Sweden and abroad. This application of the bartering system seems to be the only way of transacting business with Persia, there being a law prohibiting the export of capital from that country.

Copper and Railway Electrification.

ACCORDING to a study, just completed, by the Copper and Brass Research Association of New York, a very large new outlet for copper will occur if the Weir scheme for the electrification of main lines is carried out in this country. The world's present electrified mileage of railways, it is estimated, would be tripled and approximately 1000 million pounds of copper would be required. Although the Weir report did not go into intricate details with regard to the complete transformation from steam to electricity, the data given furnished a basis on which the Copper and Brass Research Association has made the following estimates of the potential copper requirements. For generation and transmission, 80 million pounds; conversion, 30 million pounds; distribution and contact, 660 million pounds; auxiliary feeder, 35 million pounds; equipment, 170 million pounds; and signals and auxiliary power, 25 million pounds, the sum total of which is 1000 million pounds. The Weir report estimated that the quantity of copper required for overhead lines would exceed 660 million pounds on a basis of 16,000 lb. per mile of main track, and 5500 lb. per mile of siding. These figures, it is stated, compare very closely with the amounts required for the electrification, on a system similar to that contemplated by the Weir scheme, of the Illinois Central Railroad in America.

A New Ferry Steamer for Wallasey.

AT the monthly meeting of the Wallasey Council, which was held on Friday of last week, July 3rd, it was unanimously decided to place with Harland and Wolff, Ltd., the order for a new ferry steamer, at a cost of £43,290. The council decided to order a single steamer, as it is of the opinion that the ferry undertaking can be effectively run with seven instead of eight vessels, and that continuity of service can be maintained with the smaller number. The new ship will have a measurement of about 350 gross tons and will be designed to carry 2500 passengers. Her design will incorporate a spacious sun deck, in addition to other interesting features. She will be built at the firm's Govan Yard. As the last ship on the stocks at Govan—the Anglo-Saxon oil tanker "Conch"—was recently launched, the new order will be a most welcome one. The "Conch," we may say, is a fine example of modern tanker construction, and is designed to carry about 11,500 tons of petroleum in bulk; she is of the Anglo-Saxon three-island type, with a short forecastle, a bridge amidships, and a poop with a boat deck aft. She has twenty-one oil tanks, and her machinery, which is of the Harland-B. & W., six-cylinder, four-stroke, single-acting type, is placed aft and is designed to give the vessel a speed of 12½ knots.

A New Darlington Industry.

ON Thursday of last week, July 2nd, the production of rustless iron was begun at Darlington at the newly equipped works of the Darlington Rustless Iron and Steel Company, Ltd. The company operates the Wild patented direct process, in which the chrome iron ore is reduced in a special electric furnace. The necessary current for working the furnace is taken from the Darlington Corporation electricity works, and a feature of the equipment is the special furnace control gear which has been designed and supplied by Signor Tagliaferi, an Italian engineer. The value of the rustless iron which will be produced at Darlington in a year is estimated, according to Mr. A. H. Wild, the president of the International Rustless Iron Corporation and a brother of the inventor of the process, at about £600,000 per year. The firm is the sole licencee for the Wild direct process in this country, and the demand for the production is expected to be more than sufficient to keep the furnace working at full capacity. The manager of the new works is Mr. J. Lloyd Bentley, one of the pioneer workers on rustless iron and steel, and at present about fifty-eight men are employed, apart from the officials and the clerical staff. The large electric furnace which has now been tested is the only one of its kind in Great Britain, but it is expected that before long additions of similar furnaces to the plant will have to be made. The official opening of the new plant will take place at an early date.

A Fast Italian Motor Liner.

THE new quadruple-screw Italian motor liner "Victoria," which has been built for the Trieste–Alexandria service of the Lloyd-Triestino Line, calling at Venice and Brindisi *en route*, early this week completed her maiden voyage. She has a length of 532ft. 9in., a beam of 67ft. 4in., a depth to main deck of 42ft. 6in., and a measurement of about 13,500 gross tons. Hence she is the largest motor vessel in regular Mediterranean service. Her Sulzer propelling machinery has a total designed output of about 17,000 S.H.P., which is sufficient for a service speed of 21 knots. On her official trials the "Victoria" is reported to have attained a maximum speed of 23½ knots. Her hull was designed and built at the San Marco yard of the Cantieri Riuniti dell Adriatico, Trieste, while her engines were constructed at the same firm's San Andrea engine works. Each of the four units comprises an eight-cylinder, two-stroke, single-acting Sulzer engine, with cylinders 600 mm. by 1000 mm., giving a designed output of 4250 S.H.P. at 134 r.p.m. They are arranged in pairs in two engine-rooms, fore and aft, and the lay-out is so contrived that in the improbable event of one group being put out of operation owing to a machinery failure, the vessel can quite well proceed at a slightly lower speed with the engines of the other group. There are four 530-kW auxiliary generator sets, consisting of six-cylinder Sulzer engines, with a bore of 380 mm. and a stroke of 600 mm. The units supply the auxiliary services and the hotel load, for which over 2000 kW capacity is available. The "Victoria" has accommodation for 522 passengers. She will enable the journey from London to Alexandria to be completed in about 90 hours.

The "British Exhibitor."

IN recent years several schemes have been planned for the equipment of a special ship as a floating exhibition of British manufactures and products. The announcement is now made by Lord Auckland, the managing director of British National Exhibition Ship, Ltd., of Bush House, London, that the company has recently purchased the Bibby liner "Leicestershire," which will be reconditioned and fitted out as an exhibition ship by Cammell Laird and Co., Ltd., at Birkenhead. The ship is scheduled to arrive in the Thames early next month, and she has been renamed the "British Exhibitor." On November 1st she will leave on a cruise to the West Indies and to South and Central America. The round voyage will take about eleven months, and a further month will be available for extended stays at different ports. The "British Exhibitor" is a twin-screw quadruple-expansion engined ship of about 8000 gross tons, with a speed of about 15 knots, and a draught of 27ft. 8½in., which will allow her to berth alongside the quays at most of the ports she will visit. The accommodation has been planned to provide freedom for about 500 separate exhibits, while there will also be passenger accommodation for no less than 233 commercial representatives in first-class state rooms.

Compagnie Generale Transatlantique.

THE French Chamber of Deputies has passed a Bill authorising a Government guaranteed loan of £1,280,000 to the Compagnie Générale Transatlantique, the financial difficulties of which we recorded in a Journal note on June 19th. Considerable resistance to the measure was shown by the Chamber, and the matter was fully debated. Some amendments to the Government proposals were passed, with the result, that in return for the assistance of the Government, the company is to transfer to the State, on request before December 31st, 1931, 51,510 preferential voting shares, while if any further law restricting the rights of plural voting shares should be passed, the Government is to be given the first option for the subscription of 35 per cent. of the total share capital of the company, so that Government control can always be maintained. If resolutions or decisions which, in the opinion of the State-appointed actuaries, are likely to endanger the interests of the State are passed or adopted by the Board of Management, the actuaries will have power to veto such measures until the Minister of the Merchant Navy has given a ruling. The present arrangement is provisional. The final position is to be determined before the end of the year and the connection then entered upon will continue for sixteen years.

The Yallourn Lignite-Operated Electric Generating Station.

WE have on several occasions, notably in our issue of February 16th, 1923, described the lignite-operated electric generating station at Yallourn, which forms an important part of the supply system of the Victorian State Electricity Commissioners. We are now able to give our readers some additional particulars regarding the coal deposit and this interesting undertaking, which includes, in addition to the generating station, an extensive briquette factory.

FIG. 1—AERIAL VIEW OF YALLOURN

It will be remembered that the Yallourn station has been built on what is foremost among the most extensive and readily accessible deposits of brown coal in the world. The Latrobe Valley, Gippsland, in which Yallourn is situated, is estimated to contain 27,000,000,000 tons of lignite or brown coal, or about two-thirds of the known deposits of brown coal in the State of Victoria. In the area of 30 square miles, which embraces Yallourn, there are about 6000 million tons of the material, all of it readily to be won by open-cut working and all lying within a radius of 6 miles from the power station. The coal is described as being "geologically not very old—probably not more than 20 million years." Although that may sound a fairly long period, the material, it is stated, is to be regarded not merely as a young coal, but as a comparatively young lignite. It contains a considerable percentage of coniferous tree stems, together with half-decayed leaves, spores and seed vessels. Much of the material may be readily recognised as reeds, ferns, and trees which are similar to the vegetation which flourishes at the present time.

The average depth of the deposit in the neighbourhood of Yallourn is about 200ft., and that of the overburden 50ft. At the moment, the thickness of the seam being worked is 180ft., while the overburden averages only 30ft. Nowhere in the world, it is claimed, is the ratio of fuel to overburden more favourable—nowhere, perhaps, is it so favourable. The coal is reported to have a high calorific value, to be clean, to burn evenly and smokelessly, and to have a small ash residue.

The first definite mention of the deposit was made in 1874. Nothing was, however, done in the way of making use of it until the early 'nineties, when an attempt was made at private exploitation, a briquette plant having been installed in 1894. The briquettes produced were of good quality, but in comparatively small quantities, and the project ended in commercial failure. As now being worked, however, the deposit, hitherto neglected, or at the most "scratched," has enabled the State to afford abundant supplies of electrical energy for industrial purposes, and for lighting the homes of the people. At the same time about 600 tons—a quantity shortly to be doubled, if, indeed, the increase has not already taken place as we write—of briquettes a day are being contributed to the general fuel requirements of the State, which is now entirely self-contained in the matter of electricity supply, and is well on the way to complete independence from outside sources of fuel supply for every purpose. Before the Yallourn plant was put into operation, Victoria was in a state of vassalage to New South Wales for fuel supplies for electrical and general purposes. It was, moreover, subject to frequent and embarrassing industrial interruptions at the mines and on the water fronts, and had to face the continually soaring price of black coal. Now, however, by the employment of the most modern types of machinery and equipment for the excavation and transportation of the brown coal, that fuel has put the generation of electrical energy on a more economical basis than would have been possible with the imported black coal.

The lignite, as it is now being mined, contains about 63 per cent. of moisture. In other words, there is in every ton of the coal some 12½ cwt. of water and 7½ cwt. of useful combustible. The successful commercial utilisation of such a fuel calls for cheap production. That is ensured at Yallourn by the large outputs of individual appliances, as well as by the ingenious series of mechanical operations which have been devised, so that the coal reaches the boiler furnaces, the store heaps, or—in the form of briquettes—the railway trucks or local storage yards, without having once been touched by hand. In the whole series of operations, which starts with the stripping of the overburden and ends with the supply of the coal to either the power station or the briquetting factory, mechanical means are employed throughout.

It may here be explained that the State's electric supply system, which involves the interlinking of several super-power stations, comprises some 1500 miles of high-tension transmission lines, and serves a widely separated and comparatively sparsely populated territory. On its appointment, the State Electricity Commission set itself to concentrate, co-ordinate and regulate the supply of electricity throughout the State. Individual power stations, limited in range, existed for the supply of electricity to the larger centres, but hardly any of the smaller places had a supply at all. In consequence to a large extent of the operation of the Yallourn station, the Commissioners have been enabled to shut down some fifty individual power plants or to merge them into its general scheme, and a supply of energy has been made available to about 100 smaller towns throughout the State, which previously had little prospect of obtaining a supply from any other source, at any rate for an indefinite period. Every year the Commission takes a comprehensive survey of requirements and considers what are the most economical means of providing for them, either by the extension of existing generating plants or by the exploitation of fresh sources of supply. It is of interest to note that in no single year has the demand been less than it was calculated that it would be.

The distribution network is wide and complex. In the metropolitan area at Melbourne there are three terminal stations. That at Yarraville receives energy from the original Yallourn station; that at Richmond the energy from the extended Yallourn station; and that at Thomastown the surplus energy from what is known as the Sugarloaf-Rubicon hydro-electric undertaking, the North-Eastern district being supplied direct from a station known as Rubicon "A." All these stations are inter-linked, and in the event of an interruption at any one of them, the others could take up the loading. Should the hydro-electric undertaking break down, energy could be sent from Yallourn to the border of New South Wales through Yarraville and Thomastown. The transmission voltage between Yallourn and Yarraville is 132,000. At the latter station the voltage is stepped down to 22,000 for transmission to various sub-stations throughout the metropolitan district, current being finally supplied to consumers at 240 volts.

Originally, the power plant at Yallourn had an installed capacity of 62,500 kW, say, 80,000 H.P. What is known as the Newport "A" Station—which is situated at Melbourne—was then the only other generating station in the State's system. Its capacity was about 26,000 H.P. The combined outputs of these two generating stations enabled the State to carry on until the winter of 1927. The addition of a new 12,500-kW unit at Yallourn and the coming into operation of the mountain streams section of the Sugarloaf-Rubicon hydro-electric scheme allowed the increased demand of 1928 to be met. The station at Sugarloaf was completed in 1929 and was followed by that at Richmond, so that the 1929 increment of demand was satisfied. The Sugarloaf-Rubicon scheme provides a minimum regular output of about 20,000 H.P. With a normal capacity of, roughly, 150,000 H.P. the entire equipment, as it stands, will be able to meet the requirements up to and including next winter, when the first of three new units, each of 25,000 kW. will be in operation at Yallourn. The full new instalment at that station is estimated to meet requirements up to 1935. The new plant at Yallourn and the extended briquetting factory, which was due to come into operation towards the end of last year, will require an output of coal of 10,000 tons a day in 1931, rising to approximately 13,000 tons in 1932.

FIG. 2—YALLOURN POWER STATION

In the solid bed of coal in the open cut a dredger

is excavating to a depth of about 100ft. Its capacity is some 4000 tons in eight hours, although, under test, it has excavated at the rate of 1000 tons per hour. On the floor of the cut a Ruston power shovel is at work reducing the level to 100ft., on which, towards the end of last year, the installation was begun of another deep dredger to remove the deposit down to the bottom of the deposit. The Ruston shovel was the chief coal-winning appliance at Yallourn until the advent of the dredger. The steep, rough banks of the cut, 80ft. high, bear witness to its operations, and are in sharp contrast to the smooth sloping bank left by the dredger. The shovel is supplying the needs of the briquetting factory in conjunction with a cable haulage railway. Electric transportation of both coal and overburden is now the standard practice. At the time the descriptive matter from which this article has been prepared was written—that is to say, towards the close of last year—the locomotives, then in operation, were shortly to be driven by a steep, electrically-operated haulage running direct from the open cut to the power-house bunkers. This haulage system will have an inclination of about 1 in 6 and will be capable of delivering 12,000 tons per day, with one man per shift at the bunkers. It is said to be the latest development in the economical transport of open-cut brown coal on a large scale.

Not the least interesting feature of the scheme is the model town which has been created at Yallourn. It has tree-lined streets, public gardens, wide open spaces, recreation grounds, varied types of houses and fine public buildings, and it forms a noteworthy example of modern town-planning ideals. All its thoroughfares radiate from a square which contains banks, a post office, and other public buildings. The town was literally carved out of the primeval bush, and there was no difficulty in laying it out in accordance with its designer's ideas. Every building put up, every garden created, in fact, every tree planted, had to have its place in the town picture and had to conform to the plan laid down. The Commissioners' employees are described as living in ideal surroundings and as constituting a contented and perfectly self-contained community.

We reproduce, herewith, and on page 40 a series of views taken in the district. The engravings given on page 28 represent first of all a general view of the undertaking, in which may be seen the open cut of the lignite mine, the power-house, the township, and the first span of the 132,000-volt transmission line on its way to Melbourne. Then there is another aerial view in which may be seen the power-house, the switching sub-station, the lignite reserve dump, &c. In Fig. 3 on page 40 is seen the overburden dredger in operation. The buckets of the dredger discharge into a hopper, which forms part of the machine, and the dredged material flows into trucks beneath. Electric locomotives haul the trains of trucks to the dump, where it is mechanically discharged and stacked. The dredger can operate both above and below rail level. Fig. 4 shows the cable haulage line for taking the lignite to the briquette factory, seen in the distance. The cableway is nearly a mile long. The coal winning dredger is seen in Fig. 5. As in the overburden dredger, the buckets empty the coal into trains of trucks for conveyance from the site. The dredger has a double portal, so that two lines of trucks can be accommodated, the material being discharged, at will, into either line of trucks so that operation is continuous. The trucks hold 20 tons of the coal and trains of five are hauled by electric locomotives. The trains are mechanically discharged at the power-house into a concrete bunker, capable of containing 1500 tons. From it the coal is taken either to the boilers or to the reserve dump by belt conveyors, on to which it is delivered at the bunker by loading machines. An ingenious and economical adjunct to the dredging operations is seen in Fig. 6. By it the railway tracks are moved back from the working face to make fresh material available for excavation. It comprises a cantilever, one end of which is attached to a locomotive, while the other end has a movable head. The latter is furnished with grooved rollers, which grip the heads of the rails, raise both rails and sleepers from the ground, and shift them sideways to the new desired position. The locomotive pushes the track-shifter along the length of rail to be shifted and the machine drags the track sideways for its full length and relays it in its new position.

Institution of Naval Architects.

No. II.*

SUMMER MEETING IN PARIS.

FOLLOWING the discussion on the paper by Sir John Biles, on Tuesday, June 30th, reported in our issue of July 3rd, a paper entitled "Note on Some Researches and Tendencies of Contemporary Naval Construction," by Monsieur Charles François, was read.

CONTEMPORARY NAVAL CONSTRUCTION.

In the introduction to his paper Monsieur Charles François referred to the excellent paper presented by Sir Eustace d'Eyncourt in July, 1922, at the Sorbonne, which dealt with the tendency of warship design as affected by the war. His own paper would, he said, be much on the lines of that paper, with the addition of fresh matter and views. He paid tribute to the Directors of Naval Construction and the Engineers-in-Chief of the British Admiralty, who had designed ships of remarkable endurance and efficiency. His French colleagues tendered their cordial admiration of the work and enterprise of British naval constructors and engineers.

Monsieur François then went on to review the profound changes which had taken place in naval construction since the beginning of the present century, which, he said, were due principally to three causes :—(1) Lessons of the war ; (2) scientific and industrial development ; and (3) international agreements. The rapid advance in the production of metals and alloys used in the manufacture of naval propelling machinery was commented upon. Turbine machinery now required only from one-fourth to one-fifth the space it did twenty years ago. Naval engines could now be designed of 28 lb. to 30 lb. weight per S.H.P., only requiring 86 square feet for 1000 S.H.P., while recent British liners with propelling machinery similar to that of destroyers and cruisers had been able to reduce their oil fuel consumption to 0·6 lb. per S.H.P.-hour.

The internal combustion engine had introduced a new factor, and in its various forms with the direct or the geared drive, it offered an efficient and competitive form of propulsion. The German cruiser "Deutschland" and the cruiser "Leipzig" were examples of its application. The relative advantages of turbines and oil engines were then discussed, and electrical propulsion, which had not as yet been greatly adopted for naval purposes, except in the American Navy, was also touched upon.

Monsieur François then went on to consider the relation between science and technical problems, particularly as regards technical education in France. He then passed on to the problems of the limitation of armaments and tonnage in their relation to warship design. The employment of high tensile steel and welding as further aids to hull strength was briefly considered.

In conclusion the author offered three distinctive traits or characteristic considerations with regard to modern naval construction. These were :—

(1) *The Problem of Superstructures.*—Not long ago it was customary to consider the hull arrangements of a ship as the most difficult part to design satisfactorily. That was not quite the case to-day ; in the bowels of the modern warship the arrangement and disposition of the engines involved, as had already been shown, extreme care in the saving of space and weight, and in providing protection for the vital parts below the water line. This protection, of course, required space, but the use of liquid fuel had helped in this direction.

In the superstructure, on the other hand, the various innovations due to naval exigences had created new and difficult problems. For example, the main gun armament had been increased both in number and size of guns, and their lengthening in order to increase the range. Consequently, a larger surface of the upper bridges had had to be protected from the effect of gunnery blast.

The provision of aeroplanes and their launching devices.

The development of anti-aircraft gunnery.

The extension of many devices in connection with gunnery and range-finding, &c.

It would be seen, therefore, that the naval architect of to-day found in many cases extreme difficulty in designing and fitting in the details of superstructures. Especially was this the case with battleships, where the problem of the superstructures was a very special one.

(2) *The Problem of Cost.*—It was easy to see that rapid scientific progress in modern industry and research for the improvement of materials had led to an increase in both the cost of raw material and of the completed machinery.

Indeed, if the technical progress already spoken of was the primary cause of the increase in price, it would be the case that the international agreements previously mentioned had been responsible for hastening this rise by replacing a competition in quantity by an even more general and extensive competition in quality.

And here was a point, the only one no doubt, where the forecast of Sir Eustace d'Eyncourt in July, 1922, might not appear to have been fulfilled. He (the author) referred to the fact that the reductions in cost of naval programmes due to the Washington Agreement had not been as substantial as was anticipated, for the international agreements had only limited one of the factors of naval cost, namely, the amount of tonnage to be built. The other factor, namely, the cost per ton, tended to increase considerably owing to the highly specialised character of modern naval construction, together with the more active competition in design.

Had we not before us the recent example of a special type of ship, the cost of which, if the ship were a normal one, would correspond to a ship of a displacement at least twice as great ?

It was difficult to see any remedy for this state of things if no financial limit was to be imposed. But such discussion would carry us into politics, which on the present occasion must be avoided at all costs.

(3) *The Function of the Present-day Engineer.*†—The function of the technician and engineer had considerably grown in importance in recent years. Societies such as the Institution of Naval Architects must feel proud to observe this evolution in which technical men had taken part, for they had assisted in the extension of their scope of duties.

In the keen and world-wide competition of to-day, the engineer was the staff officer of peace time. His duty was to organise the whole and to perfect each constituent part.

In devising all means of production and the creation of wealth we also found the financier, the jurist, and the business man playing their part. They all contributed to production, but they did not create it. They might play leading parts as organisers, and in certain countries at certain times the part they played was preponderant, sometimes to the detriment of the engineers. At the present time, however, world conditions had become more and more technical, and the organisation of industry must needs be drawn more and more into the realm of the technical engineer.

In a valuable paper presented on May 6th, 1930, before the Society of Civil Engineers of France, Monsieur Lucien Romier, speaking of the social *rôle* of the technician, argued that in France the technical man did not enjoy the rank and dignity which he should do. He considered that the technical engineer played the principal part in the creation of riches, and as such, at any rate in new countries, he should receive his full share of popular support. Popular opinion, said Monsieur Romier, was now voluntarily reconstituting its aristocracy and its leaders. The prestige of a great engineer, or constructor, or inventor was perhaps greater to-day among the people, the workmen, and the artisans than it was among the bourgeois classes. "This psychological phenomenon will tend towards the leadership of society in, say, ten or twenty years, becoming such that when a lawyer speaks men will merely smile, but when an engineer speaks they will obey his instructions."

It must be remembered that Monsieur Romier was addressing a congress not only of technical engineers, but a general audience of French people. We might, therefore, welcome this pronouncement of the great *rôle* which lay before the engineer, and this appeal to raise his status in the human family as one who might be regarded as the best of its servants, and whose traditions might be said to consist of labour and loyalty, uprightness of thought and action, and dis interested motives.

There appeared, therefore, to be a close bond of union between the prosperity of the State and the worth and efficiency of its engineers. Given the formation of a body of engineers of high standing and sufficient in numbers, with sound methods of education, they would constitute a capital element of the greatest value to the future of society.

Sir Eustace Tennyson d'Eyncourt, in opening the discussion, congratulated the author on the wonderful way in which he had brought forward the various important points which affected naval construction at the present time, and the manner in which he had shown how that science had developed up to its present stage. In the paper which he himself had read at the meeting of the Institution in the Sorbonne nine years ago—to which the author had so kindly referred—he had endeavoured to indicate the chief lessons learned from the war, and Monsieur François' paper now indicated the further development of naval design which had taken place since. He was in absolute agreement with the author regarding the difficulties which now beset the naval designer. The increase in scientific and industrial development, although it enabled the naval architect to do more on the same weight, had added enormously to his burdens. By the intense development of various new processes and inventions it became ever more difficult to combine in one design of ship, whatever its type, the best compromise embodying the most essential features of new developments. The mere fact of the increase in science made for specialisation in every branch, and no mind could be expected to have full knowledge of all the different scientific inventions which went to make the successful complete warship. Every specialist, moreover, wished his own particular speciality most highly represented regardless of the wishes of the other specialists who were equally keen on their particular ideas being embodied. The naval architect therefore had to make a choice and, like the old man in Æsop's Fable, if he tried to please everybody he ended up by pleasing nobody. Thus the development of scientific knowledge became a matter of embarrassment rather than assistance to the naval architect. The figures in the paper comparing the oil engine and the steam turbine hardly did justice to the great advance which had been made with the latter in recent years, and especially to the most recent results obtained with high temperatures and pressures. In H.M.S. "Acheron," a torpedo-boat destroyer which recently completed her trials for the Navy—being built by Messrs. Thornycroft and engined by the Parsons Company—the consumption of fuel was 0·608 lb. per S.H.P. per hour, which was a considerable advance on anything which had hitherto

* No. I. appeared July 3rd.

† In the French text, the term "engineer" includes that of naval architect.

been done, and there was no reason why an economy of a similar order should not now be obtained in the ordinary way.‡ The figure of 0·42 lb. per H.P. for the oil engine was compared by the author with 0·77 lb. for the turbine, but this latter figure might certainly be taken at 0·63 lb., or not more than 50 per cent. increase in fuel consumption over the oil engine. This considerably modified the other figures in the paper and the turbine, on this basis, with its present development, was not far behind the oil engine; moreover, in practice the turbine always seemed to be able to get a little extra power, when required, to a much greater extent than the oil engine. However, the whole development was one of extreme interest, and the figures of the new German warship "Deutschland" certainly indicated that the Germans had obtained a much lighter engine than the usual ordinary oil, though whether the efficiency would be as great as that of the turbine remained to be proved. The equations in the paper showed very clearly the variations of weight which might be taken for different types of ships. The difficulty was to settle the percentage which might be accepted for the weights of the various components. The limitation of tonnage laid down by the recent Treaties certainly fixed the total displacement, and one feature of the ships, viz., the guns, and it did not make the task of the naval architect any easier, which was to embody all the other necessary features on a strictly limited weight. Although the problem was an exceedingly interesting one, it still further constricted the boundaries within which the naval architect could develop his design. He agreed with the conclusions in the paper and also he agreed that he was wrong in the paper which he read in 1922 regarding cost. He certainly did not realise at that time to what extent the cost of ships would increase largely owing to the enormous scientific developments and the necessity for combining the highest possible qualities with a limited weight.

Monsieur Barrilon said the striking feature of the paper was the emphasis laid on the necessity for the naval architect to be a man of high scientific attainments. The papers presented to both the Association and the Institution had hitherto dealt either with the material, the technique or the theory of ship construction, and the paper laid it down that a scientific training was necessary to appreciate all three as a whole. It was strange, he remarked, that the early naval architects had not written biographies which would help beginners as indicating the course of their development and progress in life. Failing such biographies, he had endeavoured to form some idea of what celebrated naval architects thought about the training of engineers, and from the scanty material available he had arrived at the conclusion that those naval constructors who had shown the greatest aptitude for theoretical study were also those who realised most fully the importance of practical experience. It would be a matter of great interest to have some opinions from English engineers on this question of training or, perhaps, some opinions of their predecessors, because the pooling of opinions of English and French engineers should produce some sort of agreement as to the most suitable course to be followed during the student period, in order that they might develop into engineers with an insight into the characteristics of the vessels they built from both the technical and economic aspects. A notable phrase in the paper was that the warship having the most "showy" characteristics would not under stress necessarily prove the most reliable. One of the most important duties of the naval constructor was to provide for defence, but when he came to design he usually found that one party demanded an increase of guns, another more torpedo tubes, another greater speed, and yet another more convenient quarters, and when the naval constructor put in a plea for defence he had to meet all these varying opinions. The paper showed the way to give due consideration to all these factors without sacrificing the defensive qualities which the author regarded as essential in naval construction.

Professor T. B. Abell spoke with regard to the relation between science and technical problems mentioned in the paper. It was stated that in France the object sought was to turn out from the colleges men capable of becoming savants or engineers. The underlying idea, both in England and in France, was the same, viz., to produce men who were thoroughly equipped in fundamental science. The majority of the students were fairly well equipped in this way, but it was often found that they failed when it came to the higher standards of knowledge. Only a few became what in France were known as savants, whereas the others became practical engineers. At the same time, the maxim must always be that the training of the engineer must have a scientific foundation.

Monsieur J. Pinczon, referring to the statement in the paper that the use of high-tensile steel was first made on the Cunard liners "Mauretania" and "Luisitania," said that as a matter of fact seven years before those ships were constructed—*i.e.*, in 1898—the Penhoet shipyards had used a special steel of that type for the decks and superstructures of the mail steamers "Savoie" and "Lorraine." The idea had emanated from Monsieur Dayard, who was at that time chief engineer of the Compagnie Générale Transatlantique.

Mr. S. V. Goodall said that the author had pointed out what seemed to be demonstrably true, viz., that, with the limitations introduced by international agreements, the cost of the unit had increased. Reference was made to the remarkable ship which had been produced by the German Navy, and the one thing which was known about that ship was its tremendous cost. The author had referred to the arbitrary nature of some of the limitations imposed by some of the international agreements, and that must be agreed. International agreements tended to tempt the naval architect to forget the lessons of the war. One of the most important lessons which impressed itself on him was that the most successful ship was the one which was designed to do a particular job, and all other requirements were subordinated to that main feature. For instance, a ship that was fast enough to be a cruiser and yet was sufficiently powerfully armed to lie in the line, showed its weakness when the day of battle came. With limitations in price there seemed to be a tendency to require ships which were rather jacks-of-all-trades, and he could only hope they would not be masters of none.

Monsieur Salmon-Legagneur dealt with two main points: first, the effect of international agreements on programmes of naval construction; and secondly, the differences between French and British methods of training. With regard to the designs of the 10,000-ton cruisers which had been laid down since 1922, the factor of speed had, he thought, been emphasised in all designs at the expense of other characteristic features. If the formula given by the author were to be applied to the German armoured cruiser "Deutschland," then the various coefficients would be (*a*) propulsion, 8 per cent.; (*b*) fuel, 25 per cent.; (*c*) protection, 20 per cent.; and (*d*) armament, 13 per cent. A noteworthy feature of the design compared with other ships was the small coefficient for defensive armour. The author did not appear to be favourable towards the adoption of a combination of steam turbines and internal combustion engines, such as were employed on the German cruiser "Leipzig," but it would be interesting to have British views on this matter. With regard to the question of the training of naval constructors and engineers, there appeared to be a wide difference in the conceptions held in the two countries. In France the idea seemed to be to place the sole authority in the hands of a single man with a sufficiently high scientific training in all branches. In Great Britain, on the other hand, the same importance was not attached to a unified form of education, and thus it came about that naval constructors, naval architects, marine engineers, and electrical engineers each specialised in the training pertaining to their particular branches of knowledge. The British form of training was reflected in the production by the Admiralty of types of ships which were singularly robust and reliable. Would it not be possible, he would ask the author, to reconcile these different conceptions of training with a mutual advantage to both of them?

There was no time for the author to give a detailed reply, and he was sincerely thanked by the President for his paper.

The final paper of the morning was one on "The Effect of Rough Water on the Propulsion of Single-screw Ships," by J. L. Kent.

THE EFFECT OF ROUGH WATER ON THE PROPULSION OF SINGLE-SCREW SHIPS.

This paper describes the propulsion data obtained from experiments on the models of two single-screw ships self-propelled through artificial waves created in the Alfred Yarrow Tank. An account is given of the method by which records of propeller thrust, revolutions, and torque were obtained. The results of resistance experiments obtained by towing each model through smooth water and also through waves are given along with the model experiment data obtained with the fuller hull, self-propelled through smooth water and through regular waves, corresponding to 4½ft. in height and of various lengths, and for the finer model hull, in waves corresponding to 6½ft. in height.

Propulsion data collected on ships at sea in rough weather have been compared with the results obtained from resistance experiments made on models towed through waves of approximately the same dimensions to scale. From these comparisons it became evident that the loss in screw efficiency in rough water must be greater in some instances than would be expected from the change in slip; for the loss in speed could not be wholly accounted for by the increase in resistance. It was with the object of measuring the change in screw and propulsive efficiency that the series of model experiments described were made at the William Froude Laboratory. The experiments were carried out on two model hulls of $^1/_{32}$ and $^1/_{32\cdot5}$ full size respectively of the following types of single-screw vessels:—(*a*) A full form ship of 530ft. length and 11 knots maximum speed; (*b*) a finer form ship of 450ft. length and 14 knots speed.

For the full model the increase in hull resistance due to waves 4½ft. high and lengths from 165ft. to 570ft. averaged about 11 per cent. over that in smooth water, and did not vary greatly with wave length. In the finer model results this increase varied with the wave length and ship speed, from a very small percentage to a maximum of about 16 per cent. for waves 385ft. long. This model was also tested in waves 6½ft. high, and the increase in resistance over that in smooth water was more marked, amounting to approximately 37 per cent. in waves 530ft. long.

The results of the self-propelled experiments pointed to a loss of screw efficiency when the model is propelled through waves which is greater than that due to the greater slip caused by the effect of the increased ship resistance. This loss in screw efficiency is more noticeable in the fuller model, and shows itself as an increase in torque for any particular revolutions, as soon as the vessel commences to pitch. Close observation of the variation in thrust and torque records of the screw during experiments when the models were pitching in waves showed that both thrust and torque varied synchronously with the pitch of the model; and further, that both increased as the stern pitched upwards. It would appear that the increase in torque for any propeller revolutions which occurs when the model was pitching in waves was due to the propeller blades accelerating a larger transverse area of water than that of the screw disc as in the case of smooth water. Moreover, the water near the surface entered the screw at a much lower velocity than that at lower levels, and possibly also at much larger real pitch angles, due to the action of the full stern-water lines of the hull.

The effect of pitching upon the propeller revolutions in such ships is to reduce them as the stern moves upwards. This has been checked at sea by the author in single, twin, and quadruple-screw ships, and is sometimes a cause of propeller vibration.

Monsieur Barrilon, opening the discussion, said that he quite understood that, as the paper dealt only with part of an extended series of tests, a description of the apparatus used could not be given. When measuring torque and thrust, however, on a model pitching among waves, some difficulties must arise from inertia effects acting on the measuring gear, as the period of encounter with waves in some experiments was as low as 7 seconds. Therefore he would like to know if a description of the apparatus was available. He also would like to know if any tests had been made with the model rigidly fixed to the platform during the run, the object being to register the fluctuations of torque and thrust caused by crossing waves without pitching, such tests avoiding any disturbance of the measuring gear due to inertia effects when pitching. Finally, he asked if care had been taken to reproduce to scale on the model the rotation inertia of the parts corresponding to engine, shaft, and screw on the ship.

Sir Archibald Denny said he had been struck with the closeness of the results of the model experiments, and those which were obtained on the actual ship. A point he was not sufficiently clear about was the question, mentioned in the paper, of the effect of pitching on a propeller. He presumed he was not alone in the belief that when a ship kicked her stern out of the water, the engine raced, and he was, of course, referring to the old reciprocating engine. The paper, however, seemed to put this quite the other way about, and he would like the author to enlarge on that point in his reply. He congratulated the author on having had the opportunity of getting observations from actual ships, and wished that more work of that kind was done. He himself had been pressing for it all his life, but it was a young man's, and not an old man's job.

Sir Eustace Tennyson d'Eyncourt said he was in charge of the experiments at the N.P.L., which were being carried out at the William Froude Laboratory, and where the author was one of the staff. For that reason he was able to testify to the very excellent work being done there under the superintendence of Mr. Baker by Mr. Kent and other members of the staff. The present paper was an account of some of the work which was being done there and, as it explained, the endeavour was to combine actual experience at sea with the experiments in the tank. He regarded that as very important, and it was the policy of the N.P.L. to publish as much information as possible by way of papers read before the technical institutions. It was very pleasing to be able to compare the results obtained in England with those obtained in France, where the same research problems were being pursued. Mr. Baker, the superintendent at Teddington, had visited the French tank on more than one occasion, with very great benefit, and he would like to take the present opportunity of thanking the French authorities for allowing naval architects to see their work and at the same time to say what a pleasure it was to reciprocate.

Mr. H. G. Williams said the author made it clear that no scale or wind correction had been made on the thrust and torque constants in the propulsion experiments, but it was not made clear that the same applied to the resistance constants used. It seemed, however, that there had been a correction in that case. If that were so, it must affect both what the author called the quasi-propulsive coefficient and the thrust deductions. The paper marked the inauguration of a method of making the corrections which was neither Froude's method for estimating thrust deductions nor the method which was adopted in America. The method was to represent the difference between the friction of the model and the friction of the ship. In view of this difference, it would really be a very great advance for readers of papers connected with tank experiments if they would at least give the raw results of the experiments without the corrections for scale, to make it comparable with the full size ship. The behaviour of ships and models amongst waves was a subject which the author had made peculiarly his own, and it was to be hoped that the Institution would continue to have results from him.

Monsieur Barrenger congratulated the author on the work he was doing, and asked him to continue his experiments, and especially work with regard to the coefficient of fineness for cargo vessels. It was very important to know the difference in behaviour of vessels in a smooth sea and in a rough sea.

Mr. Kent, replying to Monsieur Barrilon, said it had taken four years' almost continuous work to produce a gear which would do this work satisfactorily. A great deal of time and a high degree of skill had been spent on that work, but even now it was not regarded as entirely satisfactory. So far as the balancing of the parts to represent a ship was concerned, that was not thought to be necessary, in that conditions were not produced in the tank such as were encountered at sea. A continuous swell was produced in the tank,

‡ See THE ENGINEER June, 26th, 1931.

such as was rarely met with at sea, and if that were done, and a mean result of the thrust and torque obtained, then they got what was called average fine weather at sea. The experiments did not cater for storms yet, and he did not know whether they ever would. The first problem, and it was a highly complex one, was to find out the difference between a ship on her steam trials in smooth water and when she met average fine weather at sea. As regards securing the screw to the carriage and allowing the waves to pass over it, that had been done, but nothing like the same increase in average torque was obtained as when the screw was oscillated up and down in smooth water. One of the objects of this research was to try and get a little more light thrown on the empirical factor now used. There must be skin friction correction, but that was empirical also, and he personally doubted whether it was correct. As for the screw racing when it reached the surface, he had not found that to be so. In one case he found a certain vibration started when the screw was most deeply immersed. That was with a single screw, and he had found the same thing in the vessels "Mauretania" and "Berengaria," and it could be measured quite easily.

The author was thanked for his paper, and the meeting adjourned.

The second technical session of the meeting was held on Thursday morning, July 2nd, in the Salle d'Iena. Monsieur Emmanuel Rousseau (President, de l'Association Technique Maritime et Aéronautique) was in the chair and was supported by Admiral Lord Wester Wemyss.

The first paper read was entitled "Technique and Use of Aircraft: The Relation with Naval Technique," by Monsieur Louis Kahn.

Aircraft and Naval Technique.

In introducing his paper on "Technique and Use of Aircraft and their Relation to Naval Technique," Monsieur L. Kahn said that physicists were well acquainted with the relationship which existed between the naval and the aerial problems. Although the specific gravity of water was a thousand times greater than that of air, the similitude in their flow went beyond the limits of mathematical analysis; but experiments in water, which had the advantage of being easy of application although requiring certain precautions, had yielded a number of conclusions that had proved useful in the case of sections and other component parts of aeroplanes.

Beyond this common ground, and in regard to construction and practical use, the two problems seemed to be, at first, quite distinct from one another, not to say antagonistic. One might think that the mode of construction and operation of an aeroplane weighing a few tons—which could not fly when its load exceeded a few pounds per horse-power—would be very different from that of a modern liner; but that was not so.

The paper was divided into three sections, dealing with (1) the strength of materials; (2) the economics of operation; and (3) navigation. In the first section the author dealt with the selection of a characteristic for the lightening of aeroplanes, and pointed to the gradual increasing weight of petrol, which was carried in the world's long-distance records. There were two values to every stage or lap of long-distance records which gave, on the one hand, the percentage of petrol to total weight on starting, giving the space available for the useful load; and, on the other hand, the percentage of total weight used up per 1000 kilom., which gave the aerodynamic characteristic. From 1924 to 1928 the proportion of the total weight taken up by the fuel was invariably of the order of 50 to 55 per cent., and the consumption per 1000 kilom. 7 to 9 per cent. for a range of total starting weights varying between 2300 kilos. and 6600 kilos. In 1929 Costes and Bellonte carried the record to 7940 kilom. starting with a 64 per cent. load of petrol, their fuel consumption being 8 per cent. per 1000 kilom. Although the structure was of a no doubt improved design, the consumption per 1000 kilom. had not been greatly improved upon.

Monsieur Kahn then went on to discuss the question of aerodynamic risk, and to compare it with the risk of fracture in the case of ships. He pointed out that in naval architecture a safety coefficient was employed, whereas in aeronautical construction problems were investigated by static tests. The secondary risks which tended to weaken the structure, such as sagging, bending of lattice ties and vibration were also dealt with.

In the section on actual operation, the author dealt with air traffic conditions, remarking that the aeroplane had revived direct communication over land, in places where marine navigation had superseded that form of transport. The question of cost was discussed, and some costs per kilometre-ton were given. A figure of 27f. per ton-kilometre, or, at par, about 7s. per ton-mile, had been given for air liners, with a heavy annual traffic, but that was exceptional, and a rate of 12f., or about 3s. 1d. per ton-mile, had been mentioned. These were rates which would not frighten shipping. A series of curves showing the cost of annual passenger transport by air, road, and rail was also given, the figures per passenger kilometre being shown to be of the order of 0·08f., 0·22f., and 2·45f. for rail, road, and air respectively, assuming that from 750,000 up to 1,250,000 passengers per annum were carried. The aeroplane might be likened to a "catalyser," which, although it hastened on the transformation by means of traffic, did not in regard to the mass carried alter either ship or railway transport in any way.

In conclusion, the author reviewed the problem of navigation and pointed out that although principles remained unaltered, the methods varied. He emphasised the difference between the marine and the aerial problem, bringing in the questions of weight and space taken up, pressures and speed. The method of aero navigation adopted by Costes and Bellonte in their flight between Paris and New York in 1930 was described, and some lessons deduced from it. The author also referred to floating islands as a means for improving the future navigation of aeroplanes. The chart used by Costes and Bellonte was reproduced in an appendix to the paper.

Opening the discussion, Sir Eustace Tennyson D'Eyncourt said that, speaking for the Institution of Naval Architects, he did not think it had had a paper on an aeronautical subject which could compare with that before the meeting for clear exposition of the whole position of aeronautics. Developments in the air had had a profound effect on the design of naval vessels, both from the point of view of providing them with aircraft to combat enemy aircraft and also as regards the use of aircraft for reconnaissance purposes and spotting, which was becoming of increasing importance with the increased range of guns and for assisting ships to avoid bombs and torpedoes. Some people were rather afraid that the present methods of protection of warships were inadequate, and that the air arm would obliterate the naval arm, but he was quite unable to agree with that view. An aeroplane discharging bombs or torpedoes could not be regarded as a weapon of precision. Nevertheless, that was a method of attack which warships had to meet, and he held the view that it had been adequately dealt with in recently built vessels.

Monsieur Raclot discussed the relations between the problems of resistance of material in the cases of aircraft and ships, and dealt with the experimental side of the subject.

Monsieur Henri de L'Escaille (Director de l'Aeronautique au Bureau Veritas) said the paper was an admirable summary of outstanding previous work on the relation between aircraft and naval technique, and indicated the interest that institutions such as the British and French Institutions of Naval Architects were now taking in the questions relating to aeronautics. He expressed the belief that the time would come when transportation by means of air in conjunction with the mercantile marine would take place over very long distances, involving the use of floating aerodromes on the sea routes.

Monsieur R. Boris (Ingénieur Général du Génie Maritime) regretted the absence from the meeting of the present Director of Naval Construction in Great Britain, namely, Mr. Johns, who had read a paper some 15 years ago very much on the lines of the present paper by Monsieur Kahn. That paper by Mr. Johns mentioned in almost the very same words the relationship between air and water and the developments that were possible in co-ordinating the two.

Monsieur Kahn, in his reply to the discussion, said that although there was a close connection to-day between seaplanes and Transatlantic liners, engineers had only, as yet, succeeded in launching the planes and not landing them. The catapult was giving general satisfaction, but the landing problem had still to be solved. It had been solved on warships, where co-operation between the two forces had become the chief problem of the command of the fleet and of naval architecture.

A hearty vote of thanks was accorded to Monsieur Kahn at the conclusion of his reply.

(To be continued.)

The Royal Agricultural Show at Warwick.

No. II.*

THE Royal Agricultural Society was fortunate in having a fine day for the opening of the Show at Warwick on Tuesday, but the attendance of the public showed a considerable falling-off compared with recent years—a further indication to the authorities that the charge of ten shillings for admission is excessive under existing circumstances. No more beautiful site could have been chosen than the present position. The area covered is 90 acres, and the general planning of the showyard is admirable, although the first view of the implement section is unfamiliar owing to a change in the allocation of the spaces, by which some of the most impressive exhibits have been relegated to less prominent positions. This year there are many regrettable absentees from the implement yard, and other firms have found it necessary to economise in the matter of space. On the whole, however, the Society may be considered fortunate in the support accorded to it by the engineering exhibitors.

For the first time in its history, we believe, the awards of the Society's silver medals were announced at the opening of the Show. These are given as follows:—To Richard Garrett and Sons, Ltd., of Leiston, for a compression ignition engined tractor; to Clayton and Shuttleworth, Ltd., for the harvester thrasher, which was illustrated in THE ENGINEER last week; to the General Electric Company, Ltd., for the portable agricultural "drumotor;" to Gascoignes Ltd., of Reading, for a milking machine.

R. A. Lister and Co.

One of the interesting features of Messrs. Lister's stand is the display of compression ignition engines of 5, 10, and 18 horse-power. These engines have been on the market for some time, and as readers of THE ENGINEER are aware, their special feature is the

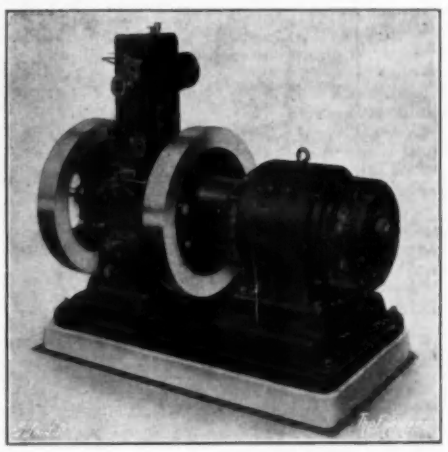


FIG. 7—AUTOMATIC LIGHTING PLANT—LISTER

combustion chamber, which enables the engines to be easily started from cold. The makers are so confident of the ready starting of these engines that they now embody them in their fully automatic electric lighting and power plants, as shown in Fig. 7, and as they operate on heavy fuels the cost of power is reduced to a very low figure. The 18 horse-power engine, of which we give an illustration in Fig. 8, has a new octagonal radiator fitted to the opposite end from that at which the fly-wheel is normally placed.

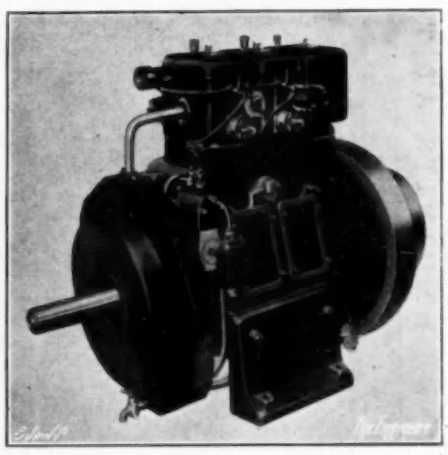


FIG. 8—18 H.P. OIL ENGINE—LISTER

This makes a compact and efficient cooling system, the fan and circulating pump absorbing only 1½ horse-power.

Gwynnes and Fosters.

The exhibits of these associated firms include a single-cylinder steam traction engine of 8 nominal horse-power, of the agricultural type. This engine, while primarily used for driving and hauling thrashing machines, can also be employed for general agricultural purposes. It has a cylinder 9in. diameter by 12in. stroke and will give continuously and economically 30 horse-power at 160 revolutions per minute, while the maximum obtainable is 42 horse-power. The working pressure of the boiler is 140 lb. per square inch. A 5-ton compound steam tractor and one of the firm's latest 4ft. 6in. thrashing and finishing machines complete the Foster exhibits. Gwynnes' exhibits embrace a trailer fire pumping set consisting of a 100-gallon two-stage fire pump coupled direct to a petrol engine—Fig. 13. This equipment is suitable for

* No. I. appeared July 3rd.

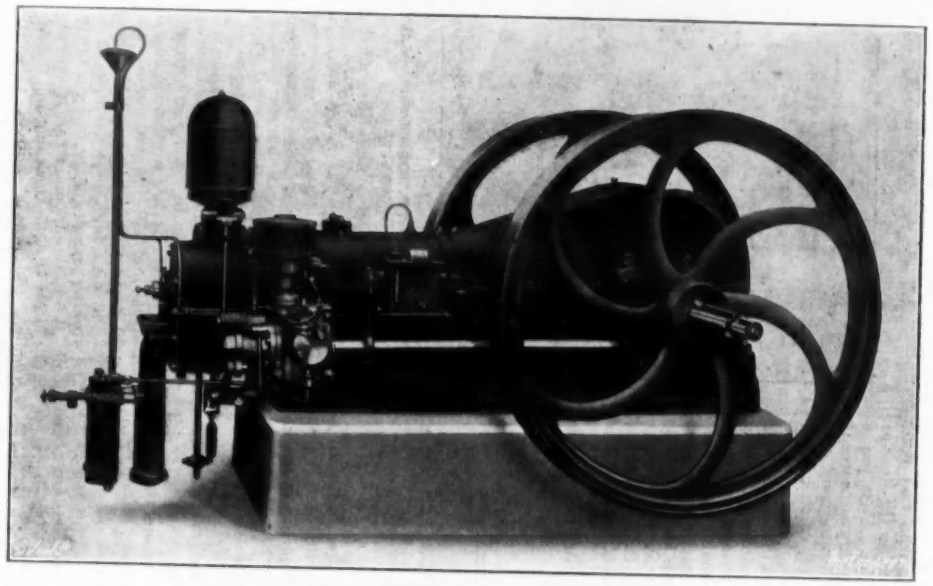


FIG. 9—15 B.H.P. HEAVY-OIL ENGINE—NATIONAL

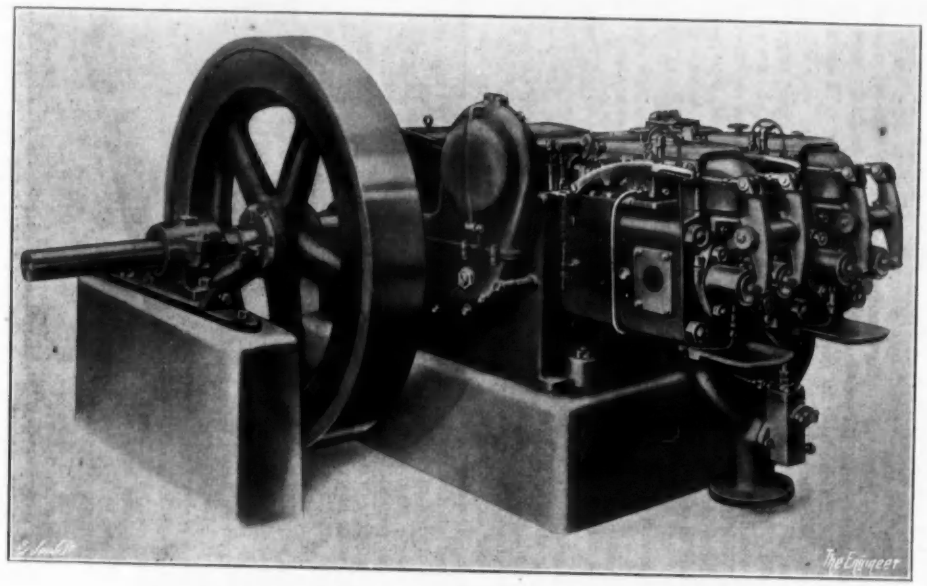


FIG. 10—32 B.H.P. TWIN-CYLINDER CRUDE OIL ENGINE—CROSSLEY

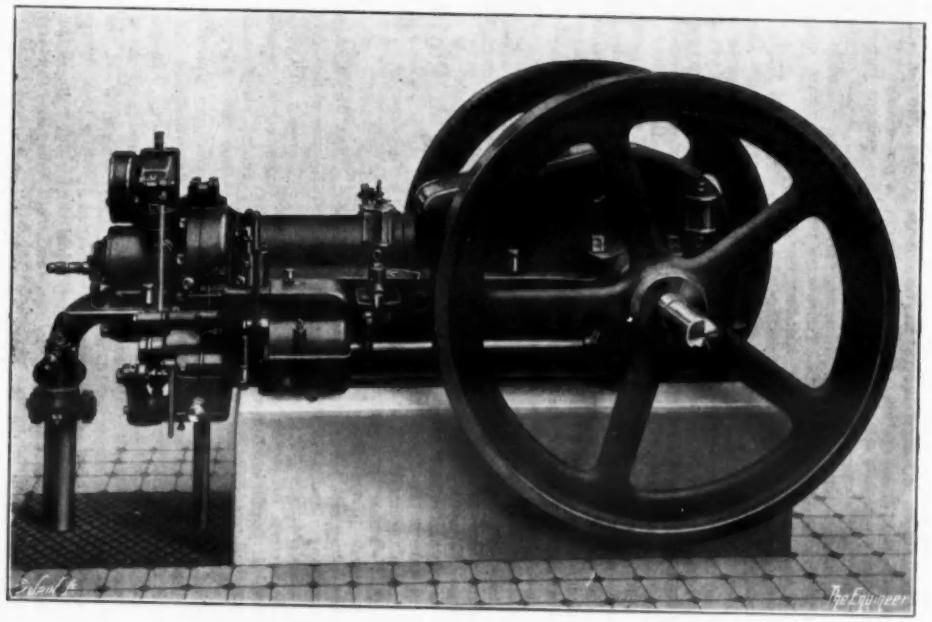


FIG. 11—SMALL COLD-STARTING OIL ENGINE—CROSSLEY

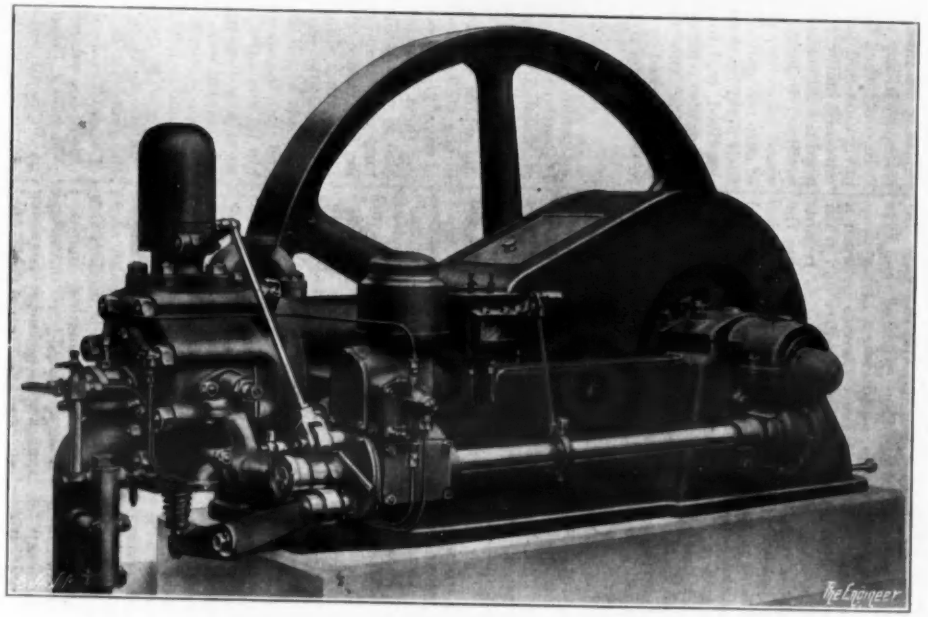


FIG. 12—AIRLESS-INJECTION CRUDE OIL ENGINE—RUSTON

trailing behind a motor car and is light enough to be manœuvred easily by hand. All hose and accessories are mounted on the trailer. The pump will deliver 100 gallons of water per minute at a pressure

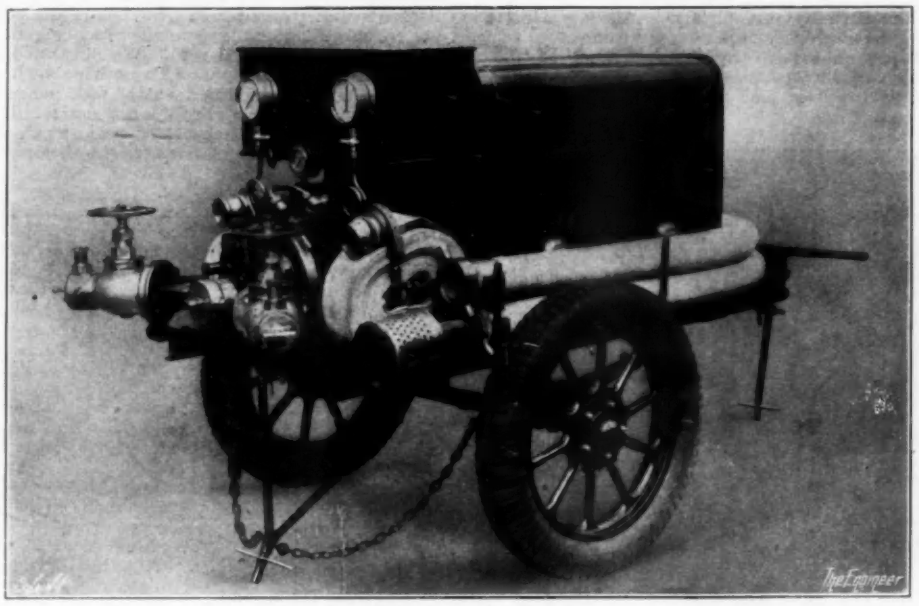


FIG. 13—PETROL-DRIVEN FIRE PUMP TRAILER—GWYNNES

of 100 lb. per square inch and in either one or two jets. It is specially suitable for country districts.

ALFRED HERBERT.

The name of Alfred Herbert is far more widely known in connection with the machine tool branch of engineering and with coal pulverisers than with agricultural engineering. The firm's knowledge of mechanical appliances has, however, been applied to the latter field with good effect in the case of the manure carrier shown at Warwick—Fig. 14. This device comprises a capacious, strong bucket carrier which can be used for a variety of purposes about farms. It can be adapted either to an H beam or I bulb track. The bucket is 45in. long by 22in. broad and 25in. deep, and the arms which carry it are mounted through heavy malleable cast trunnions riveted to reinforcing plates at the ends of the bucket. A 3in.

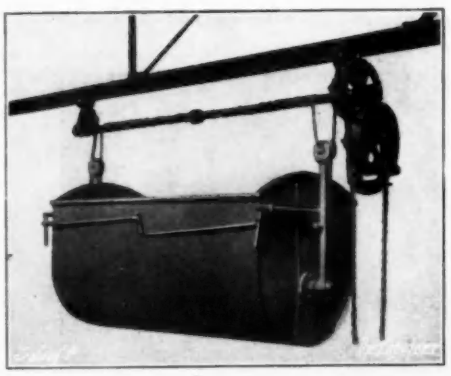


FIG. 14—MANURE CARRIER—HERBERT

diameter pulley is provided at the top of the carrier arms through which the lifting rope runs, to ensure free and easy movement. The windlass is of the hand-chain geared type, and the windlass wheel is extended to form a brake drum. Power is transmitted from the windlass wheel to the shaft through a malleable cast pinion of large diameter mounted on the end of the shaft. The lifting rope is of flexible wire, $\frac{1}{16}$in. diameter, and is suspended from the hoist and shaft brackets at the ends to the middle of the shaft, on which it is coiled in an open spiral when lifting. A tripping device is provided which engages with the carrier arm, as shown in the illustration.

CROSSLEY BROTHERS.

The stand of Crossley Brothers, Ltd., is confined to engines of small power, seven engines running on crude oil. These range from a 35 brake horse-power twin-cylinder engine to a 9 horse-power single-cylinder of the horizontal type, and 23 brake horse-power to 11 brake horse-power of the vertical, two-stroke type. There is also a collection of paraffin engines, 2½ to 7 brake horse-power, both stationary and portable, suitable for farm and estate purposes. For country house lighting a 1½ kW, 50-volt set is shown, complete with switchboard and Hart battery of 27 cells, and 100 ampère-hour capacity. Fig. 10, page 32, shows Crossley's enclosed type twin heavy-oil engine with a normal rating of 32 to 44 brake horse-power. In this design the valves are in separate cages, and the usual side shaft is abolished, the cams being chain-driven and working in an oil bath. Fig. 11 shows Crossley's small crude oil engine, which is really a miniature reproduction in simplified form of the well-known Crossley horizontal cold-starting engine. The sprayer is simplified, as also are the fuel pump and governor, although operating in the same manner as in the larger engines. Considering their small size—9 to 15 brake horse-power, these engines are very economical. The engine starts up promptly without the use of either lamp or electric ignition, and is clean in operation. The fuel oil sprayer is fitted in a water-cooled breech-end. The oil is injected toward the end of the compression stroke in the form of finely divided spray. Ignition takes place owing to the heat of compression as the crank shaft passes the inner centre. The oil pump consists of a strong body with steel valves and fittings. It is operated from the side shaft by means of a cam and lever. The cam, roller, pins and pump plunger, are all hardened and ground to size. The pump lever and cam are thoroughly lubricated from an oil bath in which the cam revolves. The governing is effected by means of a system which varies the time at which the control on the fuel pump is opened, and through which any oil not required is returned to the suction side of the system. The control valve is opened by a lever, the fulcrum of which is under the control of the governor, and varies the time when the valve is opened, in which way the power of the impulse is graduated according to the speed and load on the engine. An important feature of this gear is that the fuel pump, which has a constant length of stroke, always begins to deliver fuel through the sprayer at precisely the same time and at precisely the same speed, and the spraying is equally efficient at all loads. The actual governing effect takes place at the identical moment the injected fuel is being burned and is producing power.

NATIONAL GAS ENGINE COMPANY.

The exhibits of the National Gas Engine Company, Ashton-under-Lyne, comprise a two-cylinder four-stroke cycle solid injection engine with cylinders 9in. bore by 11in. stroke, which develops 54 constant brake horse-power at 450 revolutions per minute when running on heavy oil—Fig. 15. Starting up is by compressed air and the engine takes up full load immediately. As will be observed, the parts are totally enclosed and lubrication is on the forced feed principle. Each cylinder is provided with a separate pump and atomiser, neither springs nor compressed air being employed. The crank case is cast in one piece and the cylinders have loose liners. By changing a few parts this engine can be readily adapted to operate on gas instead of oil, thus rendering the owner independent of one kind of fuel. The inlet and exhaust valves are arranged vertically in the cylinder covers and operate directly over the pistons by means of cams on a cam shaft driven from the crank shaft by spur gearing. The governor is mounted on the crank shaft, and by means of speeder gear the normal speed can be increased or decreased 5 per cent. while the engine is running. The governor operates a by-pass valve in connection with each fuel pump so as to regulate the fuel to each cylinder in accordance with the load.

The second engine exhibited by the National Gas Engine Company, Ltd., is a small cold-starting heavy oil engine—Fig. 9—which develops 15 constant brake horse-power at a speed of 375 revolutions per minute. The engine may be started by hand, by cartridge or by compressed air. The design is clean and straightforward, the bed being of the girder type with a cover which totally encloses the connecting-rod, so as to prevent the entry of foreign matter into the bearings. As shown, the engine has two fly-wheels for industrial purposes, but only a single fly-wheel is used for electric generating purposes. A forced-feed lubricator gives a positive supply of oil to the cylinder, piston and crank pin. This engine is built in three sizes up to 24 brake horse-power.

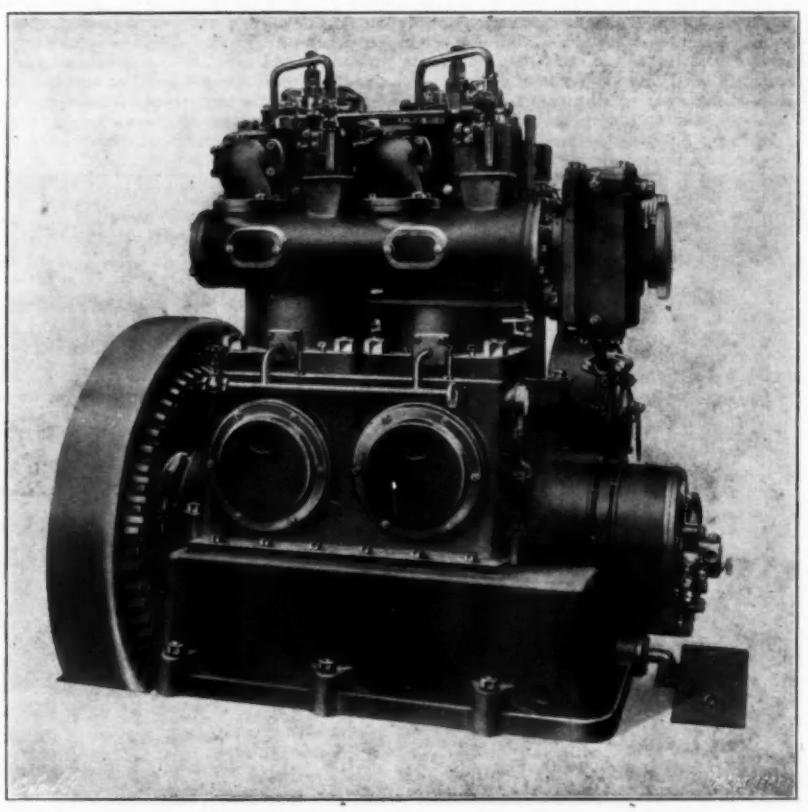


FIG. 15—54 B.H.P. SOLID INJECTION ENGINE—NATIONAL

RUSTON AND HORNSBY, LTD.

This firm's display comprises a wide range of oil engines, including the latest horizontal type, which has airless injection of the fuel and starts from cold. Although the exhibits are only of 10 B.H.P. to 22 B.H.P., they represent a range which is built in sizes up to 132 B.H.P., as illustrated by Fig. 12, page 32. Vertical engines are represented by two high-speed

units and one six-cylinder engine, also fitted with airless injection. There is also to be seen a high-speed engine with four cylinders, running at 900 revolutions per minute, at which speed the normal working load is 64 brake horse-power. This, of course, is totally enclosed and has forced lubrication. It is built for land uses and also for marine work. As a land engine the engine has a cast iron base. It starts from cold on heavy fuel. Another high-speed heavy-oil engine is a four-cylinder unit to work at 1000 revolutions per minute, at which speed the working load is 35 brake horse-power. This can be started from cold by hand. The increasing application of crude oil engines to traction purposes is illustrated by an oil roller with airless injection, cold-starting oil engine. It is of the three-wheel type and weighs 11 tons. In this case the engine is of the slow-speed, four-stroke airless injection type. The engine is simple in design and robust, while its working parts are readily accessible. It has a quick reverse by double clutches without disengaging the transmission gears. There are three travelling speeds in both directions, and the wheels, which are of steel, are water ballasted. Two powerful and independent brakes are provided.

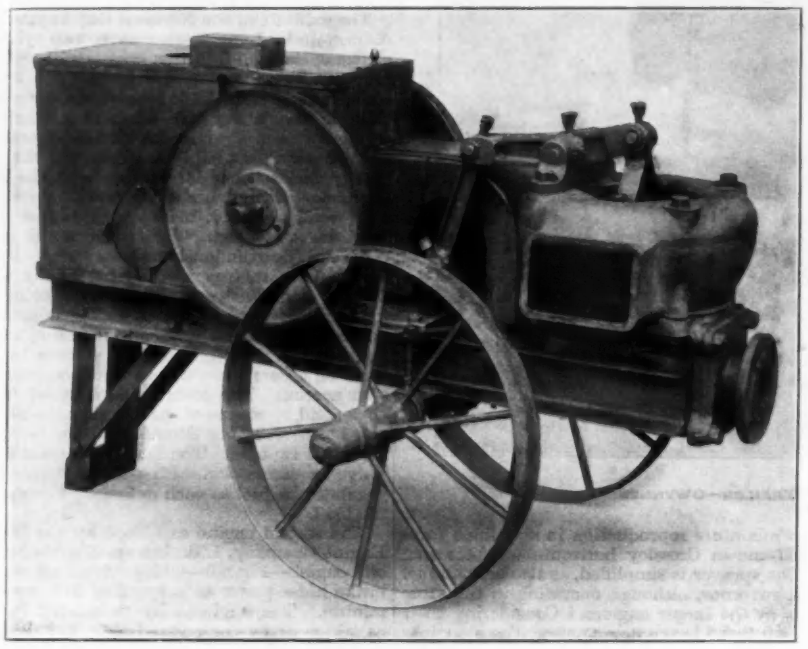


Fig. 16—6000 Gallon Diaphragm Lift Pump—Ruston

Pumps and pumping plants are well represented on this stand, and an interesting example is the portable 6000-gallon diaphragm lift pump, of which we give an illustration in Fig. 16. This is a compact unit comprising a petrol engine mounted on an all-metal chassis. The arrangement of the pump is such that new diaphragms can be easily fitted. The valves are rubber-faced and of large area. The pump is driven direct through machine-cut gears by a Ruston 2 brake horse-power petrol engine, which, although totally enclosed, gives easy access to the working parts. For contractors this set is specially suitable. The Thermax vertical steam boiler shown on this stand is already familiar to readers of The Engineer.

Ford.

The Ford Motor Company is showing vehicles in both the machinery-in-motion and commercial vehicle sections. These exhibits include agricultural tractors with various attachments, industrial tractors, commercial vehicles and passenger cars. The newest exhibit is a farm utility truck, which is designed to carry either cattle or produce. As illustrated in Fig. 17 the machine is fitted up with a long ramp, hoop sticks, and cratches for carrying cattle. The chassis is designed for 30-cwt. loads and is fitted with a 40 H.P. engine, having four cylinders, 3·875in. stroke and 4·25in. bore. The engine has a detachable cylinder head and three-bearing crank shaft. The pistons are of aluminium alloy and the lubrication is by splash and gravity feed. The engine cooling is on the pump-assisted thermo-syphon system. The gear-box is integral with the motor and gives four speeds and a reverse, and the clutch is a single plate dished driving disc. The rear axle is of the three-quarters floating type, and the final transmission by spiral bevels, ball and roller bearings being fitted throughout. As regards suspension, the Ford Company adheres to transverse semi-elliptic springs at the front and cantilever springing at the rear, the leaves of the springs being of graduated thickness.

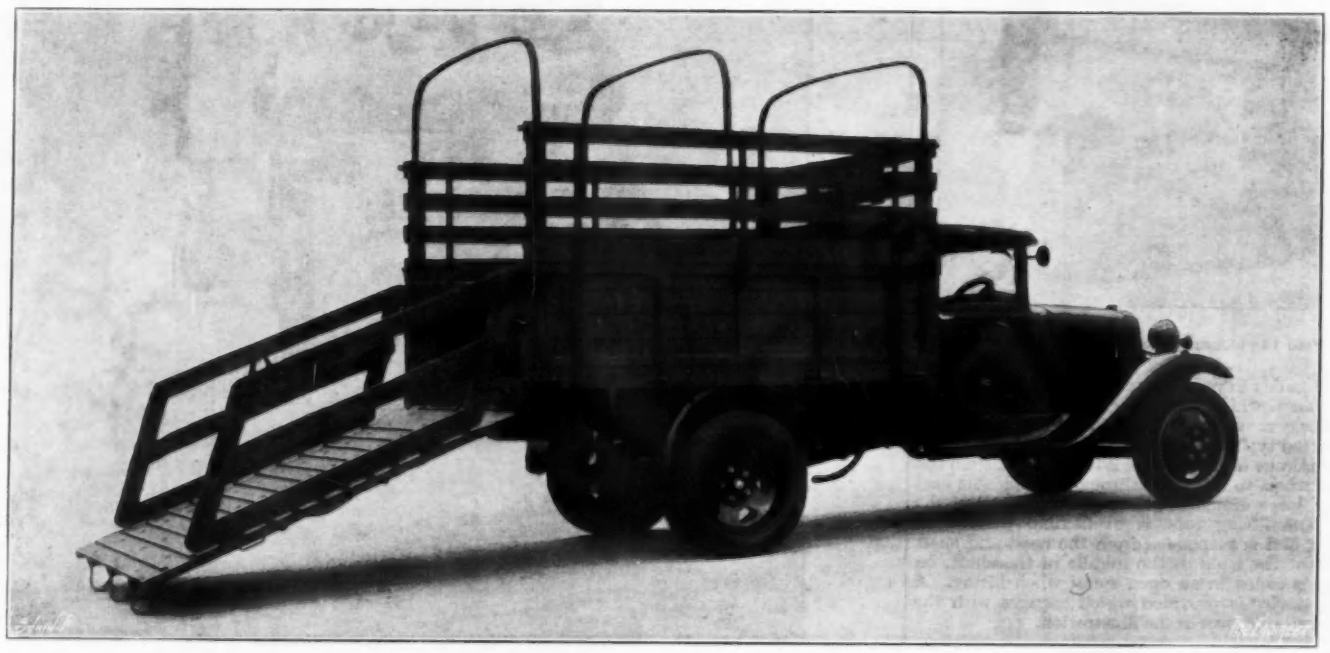


Fig. 17—Farm Utility Truck—Ford

Sentinel Waggon Works.

One of the most attractive exhibits shown by the Sentinel Waggon Works, Ltd., is a rigid six-wheeler steam chassis equipped with a special refrigerating body for the transport of perishable goods and foodstuffs. This is, in fact, a mobile cold store, in which the low temperature inside the chamber is obtained by a self-contained "silica-gel" refrigerating plant operated by steam from the wagon boiler. As this plant operates without high pressures in the piping and system generally, the compressor usual in refrigerating plants is dispensed with. We illustrated this wagon in last week's issue. Two other six-wheeled vehicles shown by the firm are fitted with pneumatic tires and have twin rear axles of a new design. These axles provide a fully compensated bogie which complies with the latest regulations for six-wheeled road vehicles.

Bamfords.

An interesting exhibit on Messrs. Bamfords' (Uttoxeter) stand is the mower which is entered in the competition for silver medals. This mowing machine embodies several novel features, the chief of which is the introduction of automatic lubrication of the gearing and bearings. The lubricating system has some special features, one being the means whereby the oil in the gear wheel bath is maintained at a suitable level. This is accomplished by a filler disposed in the lower part of the gear case, the distribution of the lubricant being accomplished by a rim formed on the edge of the large gear wheel. This arrangement enables the oil to be delivered without excess in a steady stream to the gearing, bearings, thrusts, clutch gear, &c. Special means are also provided for lubricating the bearings of the cross shaft, a pipe from the upper part of the gear case conveying the oil to that part. For lubricating the driving shaft bearings and crank pin, a pipe which collects the oil from the disc on the edge of the gear wheel conveys it to the centre of the driving shaft, through which there is a passage extending the whole length, transverse passages being provided to each of the two bearings of the shaft. At the far end of the shaft there is another transverse passage which communicates with other passages leading to the surface of the crank pin. When the mower is in operation the oil is drawn through the hole in the driving shaft and is distributed to the bearings and crank pin by centrifugal action. Another improvement in this machine consists of a "clearway" cutter bar fitted to the outer shoe to prevent clogging. This bar holds the crop firmly at the outer end, while the knife is doing its work, so that a clean cut is made in the crop, leaving a clear track for the succeeding cut. A new connecting-rod is fitted to facilitate the removal of the knife. The connection with the knife is of the ball and socket type, the socket being formed by two jaws at the end of the connecting-rod. One jaw is fixed while the other is hinged, the stationary jaw being provided with a tongue which is adapted to pass through a slot in the hinged jaw, and there is a spring-pressed lever having a projecting finger for engaging in an opening in the tongue, the latter being on the outer side of the slotted jaw when the jaws are engaged in the knife bar. The machine is exceptionally well balanced, and is light in draught.

Petters.

This Yeovil firm has an exceptionally wide range of exhibits, amongst which is the 7 horse-power Atomic compression ignition engine, shown for the first time. As will be seen from the illustrations—Figs. 18 and 19—this is a very compact unit, which by the removal of the base is adaptable for building into machinery, tractors, locomotives, &c. This engine is of the solid injection type, the normal speed being 650

revolutions per minute, which can be cut down by the governor to 235 revolutions per minute. The injection of the fuel by the Bosch pump and atomiser begins when the piston is about 36 deg. before top dead centre and continues for about 12 deg. Starting is by the heat of compression—600 lb. per square inch—and the effort of hand cranking is comparatively light, being assisted by the compression release valve fitted in the cylinder. To prime the engine, the handle shown in one of the views is used. By depressing this, the pump plunger is locked in position at any time, causing the engine to stop.

For lubrication the main bearings have rollers in contact with the shaft, which send the surplus oil into

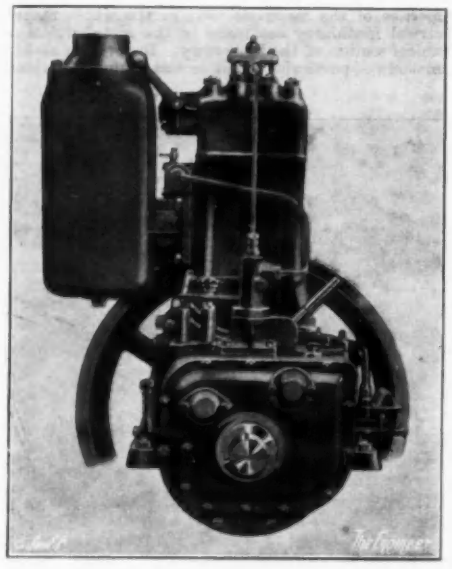


FIG. 18—7 H.P. ATOMIC ENGINE—PETTERS

a glass inspection cover placed at the top of the bearing, the oil flowing back into the sump from this cover. An excentric shaft incorporated in the left-hand bearing cover operates a calibrater lubricator, which supplies oil to the large end through a centrifugal oiler as well as to the cylinder walls. The small end picks up oil from the cylinder walls. The governor, which is housed in the bearing cover at the left-hand side of the engine, has a separate oil well in which the gear runs constantly. Crank case pressure delivers surplus oil in the crank case through strainers into the calibrater.

The cylinder head, which is cast in one piece, is of symmetrical design, and possesses no loose parts. The absence of inlet and exhaust valves with their openings in the cylinder head simplifies the design

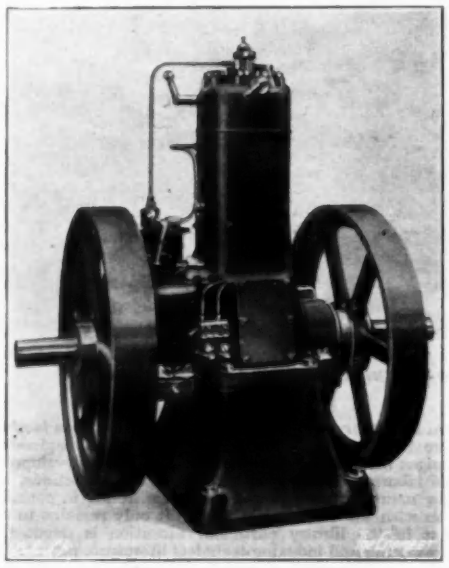


FIG. 19—7 H.P. ATOMIC ENGINE—PETTERS

of this part, and is claimed to obviate the danger of cracked cylinder heads and other similar troubles arising from unequal heat stresses. The makers also claim that owing to the simple design of the cylinder and head referred to, a further advantage is that efficiency is maintained over a long period.

Another engine of the same type exhibited is the 65 horse-power single-cylinder unit, a very strong simple engine suitable for hard work. A six-cylinder unit of this type with a brake horse-power of 400 is the largest engine at present manufactured by Petters, Ltd.

(To be continued.)

Trade and Foreign Colonies.

(By our own Correspondent in Paris.)

No. II.*

DENSITY of population is a factor which determines the value of colonial territories as a means of developing international trade. Where a country supplies produce and raw material and takes little in return, except what is necessary for its exploitation, it can offer only a limited market for foreign goods. It necessarily follows that the more a native population is engaged in the production of produce and raw material for export the greater will be its needs for what foreign manufacturers can supply. Moreover, if native growers contribute largely to an export trade the country suffers less from the effects of depression than it does when the work of development is left in the hands of European companies, whose financial stability depends upon maintaining a profit-making business. In the case of native growers each individual suffers comparatively less from a trade slump, because, having no overhead charges, he has less to lose. For that reason, in a colony with a native population that contributes largely to the export trade, contraction of demand and depreciation of values do not affect the country so adversely as when the work of development is carried out by big financial corporations. In times of bad trade the native producer can get along with little, but the man discharged from a factory loses everything. This idea underlies the policy adopted by Holland in its East Indian possessions. These offer one of the best examples of intensive development with the aid of native participation, and of the value of such participation in creating new requirements for goods of foreign manufacture, and of promoting a balance of commercial exchanges in the interest of everyone concerned.

THE DUTCH EAST INDIES.

In Java the density of population is 314 to the square kilometre. This denotes a purchasing power in times of normal trade that is clearly revealed by statistics. The returns for two years ago show that the imports into Java, mostly of manufactures, were approximately two-thirds of the exports of produce and raw material. In the other islands, where the population is sparse, the imports were less than one-half of the exports. In Java the increasing ratio of imports to exports is more rapid than it is elsewhere. In ethnological variety the Dutch East Indies may be compared with India, and there are other similarities with that Dependency, but the Dutch Colonies are politically regarded as an integral part of Holland, with a system of government which ensures unity of control and interest. In the East Indies there is no restriction on trade, and the import duties are of a purely fiscal character, affecting in the same way Dutch and foreign goods. The importance of the Dutch East Indies to Great Britain is observable not only in the trade statistics, but also in the capital invested in the islands. In 1928 Holland accounted for 18·1 per cent. of the imports into the Colony; Great Britain, 12·6 per cent.; and Germany, 10·9 per cent. Adding the imports from Australia, Singapore, and British India, the total British contribution to the imports into the Dutch East Indies totalled 42 per cent., though as Singapore is a port of transit, it is impossible to say how much of its imports into the Dutch East Indies, amounting to 11·6 per cent., are of British origin. This discloses to what extent a part of the British Empire is interested in the prosperity of the Dutch Colonies. The percentages given are based upon the latest available figures, those of two years ago. The imports from Great Britain consist largely of cotton goods, and it is regrettable to find that in machinery, tools, iron and steel Great Britain is far behind Holland and Germany, these two countries supplying about 65 per cent. of engineering products and 53 per cent. of iron and steel. Seeing that quite a large amount of British capital is invested in the Dutch East Indies, representing on the west coast of Sumatra one-third of that subscribed by the Dutch, probably through the British participation in the oil-fields, British engineers should do more in a market which is destined to become of great value when the islands are more fully developed.

Java itself may be regarded as having reached a complete state of development, and the organisation of native industries, hydro-electric installations, irrigation works, transport, the laying out of plantations with European capital, the installation of sugar factories, and even of engineering works has rendered production highly efficient, and until the general slump set in there was a steady increase in foreign exchanges. There is no intention to render Java independent of foreign goods. The engineering works that have been installed are employed solely for repairs to railway and other material. The Dutch policy is to render the Colony prosperous so that it can buy from abroad, at the same time that it supplies produce and raw material for industries that have been created in Holland for that purpose. It is worth noting that amongst the natives the quality of the goods supplied to them is judged by the trade mark, and they are purchased under the name of the mark, so that there is no better means of securing a permanent business than to associate an easily expressed trade mark with a quality that makes the best appeal to native buyers. This is the case in all Asiatic countries where native buyers have nothing to guide them except the marks on goods which give them general satisfaction.

The problem now confronting Holland is to achieve in Sumatra, Borneo and the other islands the same results that have been obtained in Java. They are all remarkably rich in mineral resources. Oil, coal, iron, tin, gold, and other minerals and metals exist, some of them in abundance, but they are mostly in the outer islands, where the population is sparse and the means of transport are inadequate. All the mining is controlled by the Government or is let out under contract to companies, and the oil wells in Sumatra and the tin mines of Banka, these latter being worked by the Government, constitute the main wealth of the archipelago outside Java. The coal is mined near the surface and often outcrops, and the present production is rather more than a million tons yearly. It is mostly friable and deteriorates on exposure. The potential wealth consists of rubber, palm oil, tobacco, tea, coffee, and other produce, but little can be done to develop these vast resources without a settled population. The Government has failed to induce the surplus population of Java to migrate to Sumatra and other islands. The Javanese are too much attached to their native soil. Mines and plantations can be exploited with contract labour, but the Dutch resort to this as little as possible. At the last Census the population, composed of a remarkable diversity of races, was 52½ millions, with a little more than 200,000 whites. Of this total more than 37 millions were in Java. If the population were more evenly distributed it would be possible to develop much larger areas of territory, but such distribution appears to be out of the question, or can only be accomplished slowly. The archipelago could support double the number and quadruple the trade. This possible extension of colonial activity in the future, if only a sufficient agricultural population can be induced to settle in the outer islands, interests the British Empire more particularly, because it surpasses Holland in the commercial participation, and even in the tonnage of shipping to the Dutch East Indies the latest figures give 44 per cent. to Holland and as much as 35 per cent. to Great Britain.

The Dutch Colonies are responsible in a large measure for the development of the engineering industry in Holland. A branch of "tropical machinery," samples of which were shown in the Dutch pavilion (before it was destroyed by fire) at the Paris International Colonial Exhibition, has been created. There were machines for tobacco, rubber, tea and coffee, and machines for stripping tropical fibrous plants. Dioramas and models showed the importance of dredging machinery in the Dutch East Indies and the extensive use of transporters on plantations. In Java there are 178 sugar factories in operation. The railways and tramways take a great deal of material, and the imports of motor cars into the Colony are steadily increasing. United States makers account for 75 per cent. of the total, the General Motors having a factory in the Colony for the erection of cars. There are schemes for extending the use of hydraulic power, which is estimated throughout the archipelago to attain more than 6,000,000 horse-power. This is merely an indication of what may be done in an archipelago of such great possibilities that there must be a continued extension of enterprise, and in view of the growing importance of the market, British engineers cannot afford to occupy, as they do at present, a position so inferior to the Germans, who are practically on a level with the Dutch in the supply of machinery and plant.

The Dutch East Indies pavilion, representing externally a Buddhist temple, contained a particularly interesting and valuable collection of everything relating to colonial art, industry and agriculture. Its destruction by fire was a disaster for the Exhibition as well as for the Netherlands Government and those responsible for a remarkably complete Javanese art collection.

(To be continued.)

* No. I. appeared July 3rd.

Obituary.

JAMES HEALEY JOHNSON.

WE announce with regret the death, on July 4th, of Mr. James Healey Johnson, M. Inst. C.E., at the age of 69 years. Mr. Johnson, who was the second son of the late Mr. Richard Johnson, M. Inst. C.E., at one time chief engineer of the Great Northern Railway, had, for thirty years, held the position of Engineer to the Witham Drainage General Commissioners and the Witham Outfall Board, and also acted as consulting engineer to the newly formed Witham and Steeping Rivers Catchment Board. Before going to Boston in 1901, Mr. J. H. Johnson had been assistant engineer on the Derbyshire District of the Great Northern Railway.

He was elected an Associate Member of the Institution of Civil Engineers in 1901, and transferred to the class of Member in 1906.

IT is reported in the South African Press that a "small-worker" recently got 35 oz. of gold in a day from a working near Que Que, Rhodesia.

A Visit to the B.T.H. Rugby Works.

NUMEROUS as our visits to the B.T.H. Rugby works have been and familiar as we have become with many of the company's products, a trip to Rugby on Thursday, July 2nd, proved quite interesting and enjoyable. Together with members of the South Midland Centre of the Institution of Electrical Engineers, taking part in their Summer Meeting, we had the privilege of listening in the afternoon to an admirable lecture on "The Growth and Development of Talking Pictures," delivered in the company's Acoustical Theatre by Mr. R. C. Clinker, who, by means of cleverly designed experimental apparatus, succeeded in showing in a simple and highly interesting way how talking picture apparatus has been evolved. Subsequently, the B.T.H. apparatus, as now in use in many picture palaces in this country, was set into operation, thus revealing the result of all the investigations and patient experimental work. During his long association with the B.T.H. Company Mr. Clinker has been engaged on various kinds of electrical work, but as a research engineer in what is known as the weak current side of the industry, he seems to have found his real vocation, and as a lecturer on the subjects in which he is now mainly interested, he is undoubtedly a marked success. How the "talkie" apparatus works is probably a mystery to many who visit cinema shows, but if a talking film were made of Mr. Clinker's experimental lecture and shown in picture palaces, it would enlighten many and incidentally add considerable value to the collection of educational films.

Those who, like ourselves, are continually visiting large engineering factories and who often see many things they have seen before, find relief in some little diversion from the orthodox tour of the shops. Although not always permissible, we like to know what is going on behind the scenes; in other words, what is taking place in the research and development departments. As we said when describing a visit to another large works some little time ago, the new conditions in the electrical supply industry have set designers many new problems which cannot be solved without experimental investigation. It is not to be wondered at, therefore, that it has been necessary to provide at Rugby an extensive experimental laboratory, devoted to the investigations of problems connected with the present and future manufacture of plant and apparatus. Occupying two floors of a steel-frame and brick building, 180ft. long by 50ft. wide, and consisting of thirty-four rooms of various sizes, the laboratory constitutes an important part of the Rugby organisation. Of the thirty-four rooms, five serve for administrative and general office work; one as a library and record department; another as an experimental workshop; whilst the others are laboratories proper, equipped with gas, water and electrical power services. Vacuum is provided, in those rooms that need it, by a pumping plant in the basement, and electrical current of any desired voltage and frequency can be switched on to distribution boards in the separate rooms. A complete manufacturing equipment similar to that used for the production of valves, &c., in the valve works is to be found in the vacuum physics laboratories. Again, in the insulation laboratories there are small replicas of the regular works plant in addition to experimental machines. Among the special apparatus that has been constructed in the laboratories is a high-frequency and high-voltage oscillator, a special filament temperature pyrometer, loud speaker output characteristic measuring apparatus, a carborundum squirting press, and complete talking film recording and reproducing apparatus.

The chemical and metallurgical section comprises several laboratories; two are devoted to chemical analysis, whilst the remaining rooms contain mechanical testing and microscopic examination equipments. Needless to say, the work undertaken in the engineering laboratory necessitates careful selection of the staff, which is drawn from the universities and from the company's apprentices. In this engineering laboratory the work can be classified under the headings of "General Electrical," "Insulation," and "Chemical and Metallurgical." All electrical and magnetic problems, including noise analysis, special iron tests, research on loud speakers, high voltage condensers for power factor correction, and small phase angle investigations are dealt with. For use in connection with the measurements of the inter-electrode capacities of screen grid valves a micro-condenser has been developed. Special high-frequency measurements are regularly made and observations are now in hand on long-distance short-wave transmissions. In the engineering laboratory the B.T.H. sound reproducer, including the valves and amplifiers and the complete talking film equipment, was developed. The first equipments were actually built in the laboratories by the laboratory staff, and, needless to say, the work involved much investigation in acoustics, vacuum physics, &c. The importance which the company attaches to its talking film business can be gauged from the fact that the acoustical theatre mentioned was specially built for the purpose, and in this theatre, which is also used for lectures and demonstrations, work is continually being carried out.

The activities of the vacuum physics section of the laboratory embrace investigations in connection with light sensitive cells, high vacuum triodes, high output gas-filled rectifiers, ultra-violet lamps, thyratrons, and special work in relation to mercury arc rectifiers. The insulation section, which is concerned with the technical control and improvement of manufacturing processes, has been responsible for the development of new materials in almost every phase of insulation engineering, and is equipped with a small replica of a large synthetic resin powder and varnish plant, operating in the main works. Investigations relating to such things as lubricating oils, centrifugal castings, forgings, protective coatings, and the general properties of the materials used in the whole range of electrical machinery are made in the metallurgical and chemical section of the laboratory. Reports on all kinds of matters of particular scientific and engineering interest and laboratory instructions issued to the various factories give fundamental data upon which certain engineering designs are based. Manufacturing processes developed in the laboratories are covered by works instructions, and new manufacturing processes are controlled in consultation with the works authorities. It only remains to add that in the library particular attention is devoted to abstracting and indexing technical literature, patents, &c. Every possible contact is made with scientific institutions and other laboratories, and there is the closest possible degree of co-operation with the various research and standardising associations that are doing important work in engineering.

The turbine factory is now equipped with seven test beds, situated towards the dispatch end of the building, and after machines have been tested there is every facility for rapid packing and dispatching by road or rail. One of the most recent and most interesting additions to the turbine department is a turbine wheel testing equipment. Protected by patents and the first of its kind in Great Britain, this equipment is intended for ascertaining the possible nodal frequency of vibration of wheels running at various speeds. As turbine designers are well aware, if the nodal frequency of a running wheel should occur at the running speed of the unit, the backward running wave of the wheel travels backwards as fast as the wheel is running

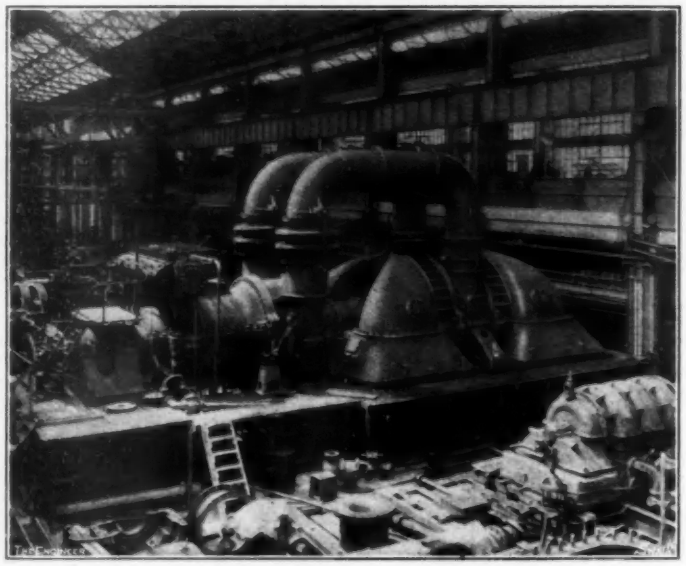


FIG. 1—TWO-CYLINDER 50,000-KW TURBINE

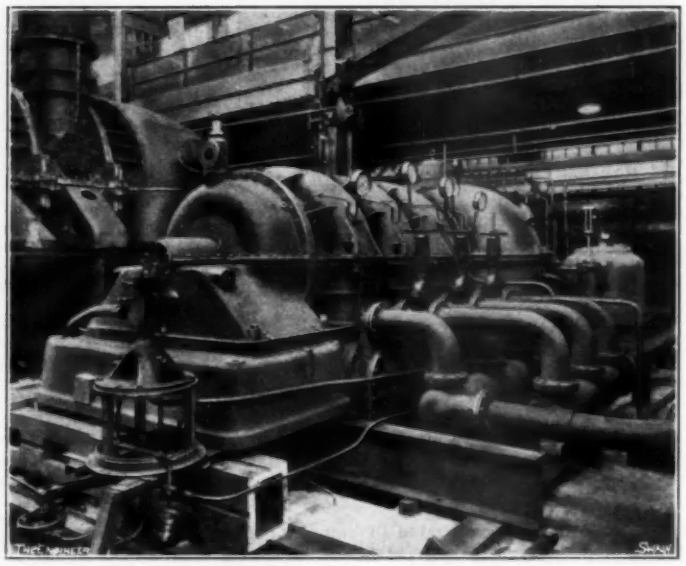


FIG. 2—TURBINE-DRIVEN AIR COMPRESSOR

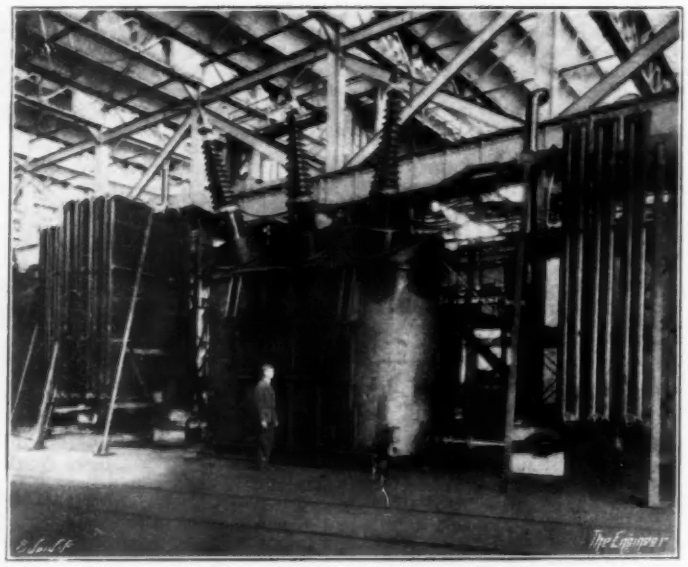


FIG. 3—20,000-KVA. THREE-PHASE TRANSFORMER

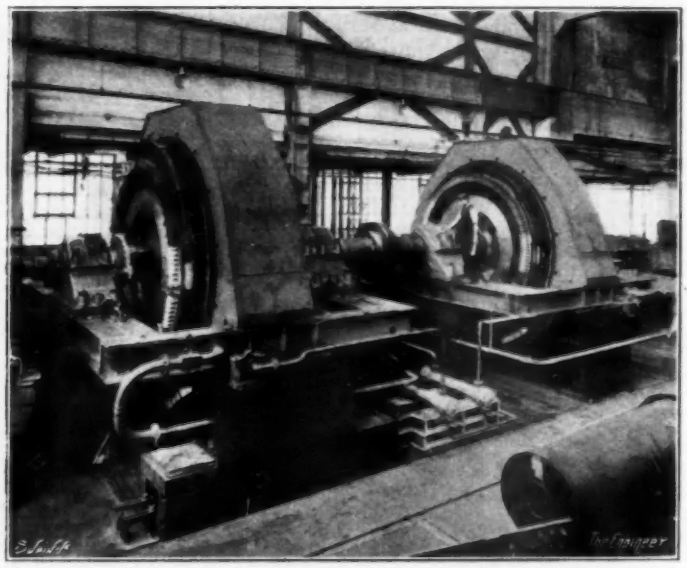


FIG. 4—12,000-KW WATER-WHEEL ALTERNATORS

forward. The wave then becomes stationary in space and can build up to such an amplitude that injury to the unit may occur. By means of the wheel testing apparatus installed in the B.T.H. works the speeds at which the wave is stationary in space can be ascertained with great accuracy, and, needless to say, the information obtained is of great value in design, especially in view of the fact that the output of turbines is continually increasing and large wheel diameters and long blades are required. The equipment comprises a sort of bomb-proof chamber in which the wheel to be tested is rotated, the top half of the casing being semi-circular in shape, so as to form a hood over the wheel under test, and to ensure safety in the case of accident the casing is made of forged steel. In the chamber, which is supplied with steam, the test wheel carrying rotating coils is mounted on a shaft alongside a heavy disc or wheel, and the shaft carrying the two wheels is rotated at any required speed by means of an external steam turbine.

Steam is supplied to the casing and the exhaust is carried away to a vacuum pump and condenser, which maintains a fairly high vacuum in the chamber during tests. The purpose of the steam in the chamber is to keep the wheel relatively cool, as if turbine wheels are rotated at high speed, even while surrounded by a medium of low density, so much heat is generated by windage that the temperature of the wheel may rise to an unduly high value. But by circulating steam through the casing to the vacuum pump and condenser the heat energy generated by the rotation of the wheel is removed and the temperature of the wheel is maintained at the desired value. In order to observe and photograph wave motions or vibrations which may occur in the wheel under test, two oscillographs are employed, together with two sets of exploring coils suitably located within the wheel testing casing. One set is stationary with respect to the wheel under test, whilst, as we have said, the other set rotates. These exploring coils

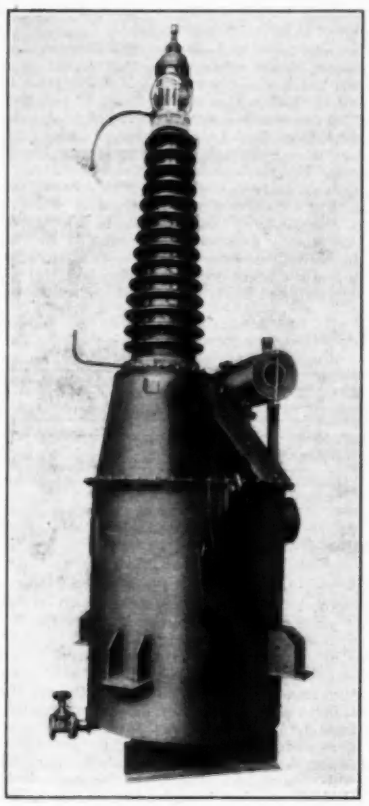


FIG. 5—132-kV POTENTIAL TRANSFORMER

are connected to the oscillographs, which record electrical indications of the movement of the turbine wheel. The stationary coils give rise to indications of the movements of the wheel rim towards and away from the exploring coil as the wheel passes a coil, whilst the movable coil which rotates with the wheel records only the lateral motion of one given point in the wheel circumference, and the records from these two coils disclose the nature of the wave phenomena developed in the wheel.

Of the turbines at present under construction at Rugby one of the most interesting is the 30,000-kW, 3000 r.p.m., three-cylinder machine for the Dagenham works of the Ford Motor Company, referred to in our last Annual Article on "The Year's Progress in Electrical Engineering." It will be remembered that the turbine is designed for a pressure of 1200 lb. per square inch and for a total temperature of 725 deg. Fah. In the high-pressure cylinder the steam is expanded down to 200 lb. per square inch and is reheated at this pressure to a total temperature of 550 deg. Fah., and in practice a large quantity of the steam at 200 lb. pressure is to be exhausted for process work. For the Dagenham factory the B.T.H. Company is also building a 3750-kW turbo-alternator and two turbo-blowers, each capable of supplying air for a 500-ton blast furnace, namely, 50,000 cubic feet of air per minute at a maximum gauge pressure of 30 lb. per square inch.

At the time of our visit parts of the 67,200-kW three-cylinder turbo set for the Battersea power station of the London Power Company were in evidence, also the two-cylinder turbine—see Fig. 1—for the 50,000-kW turbo-alternator for the Ironbridge power station of the West Midlands Joint Electricity Authority. On account of its size and weight the fabricated alternator for this set is being built up on site. Other turbine plant under construction includes two 75,000-kW three-cylinder turbo-alternators for the new Barking extension of the London Electric Supply Company—the largest turbo-alternators ordered in Great Britain—a 30,000-kW, 3000 r.p.m. turbo-alternator for the Spondon power station for the Derbyshire and Nottinghamshire Electric Power Company, a 25,000-kW, 3000 r.p.m. turbine for the Brimsdown power station of the North Metropolitan Electric Power Supply Company, two 20,000-kW, 25-cycle turbo-alternators for the Greenwich power station of the L.C.C. tramways, and a 15,000-kW, 3000 r.p.m. turbo-alternator for the Thorpe power station of the Norwich Corporation. Turbo-driven air compressors in the course of manufacture at the present time include one of three on order for the Doncaster Collieries Association. The compressor—see Fig. 2—is rated at 10,000 cubic feet per minute at 85 lb. per square inch gauge, and is to be driven by a mixed-pressure turbine.

Transformers in all stages of construction were to be seen in the transformer shops; those for the "grid" varying in output from 60,000 kVA at 132,000 volts down to 2000 kVA at 33,000 volts. On account of their large diameter the coils for one of the 60,000-kVA transformers are notable, the length being definitely limited, like that of all the large grid transformers, by transport difficulties. The core of this transformer contains over 35 tons of transformer iron, and, like all large B.T.H. transformers, the coils are wound on heavy cylinders of treated paper in order to give a firm mechanical foundation. With the B.T.H. on-load tap changing gear we scarcely need deal, as it is already well known to our readers. All disc coils without tappings are wound continuously—that is to say, without joints between sections. After they have been cleaned the conductors are paper covered, and when the end of a drum of copper conductor has been reached the end is electrically welded to the starting end of the copper conductor on another drum. Every transformer coil is given a final vacuum oil impregnation as well as a varnish impregnation if specified. A 20,000-kVA, 132,000/6600-volt transformer together with its radiator banks, erected for a test run in the Rugby works, is shown in Fig. 3, the transformer being one of those on order for the North-West England electricity scheme.

Perhaps the most interesting development in the B.T.H. transformer shops is the manufacture of potential transformers—see Fig. 5—for connection to the 132-kV "grid" network. These transformers are of the shielded surge proof type and are insulated to be stronger under impulse conditions than a 41in. gap in air, a bushing with a dry flash-over at 50 cycles of 380 kV or a string of insulators with a dry flash-over of 455 kV. Transient over-voltages and switching surges are uniformly distributed throughout the winding and not concentrated on the end turns. Transformation ratio and phase angle characteristics are maintained constant. When supplied on the F.H.T. winding and connected to a burden of 200 VA the inaccuracy does not exceed 1 per cent. in ratio and 1 deg. in phase angle, irrespective of whether the transformer is tested at the rated voltage or one-twentieth of that voltage. These transformers can be made suitable for the emergency lighting of sub-stations, the power rating in these cases being 7·5 kVA.

The seventeen 1500-kW and the five 2000-kW rectifiers ordered by the London Electric Railway Company, referred to in our last issue, are under construction in the large electrical machine shop, where two 1200-kW rectifiers for the L.M.S. Barking to Upminster electrification scheme are also being built. A 5000-kW frequency changer, two of four 1200-kW water-wheel alternators—see Fig. 4—for the Punjab Government's Uhl River hydro-electric scheme, and a 12,000-volt, 500-kW D.C. motor generator set for the new telephony transmitter that is being installed in the G.P.O. Rugby radio station, were also brought to our notice. The 12,000-kW, three-phase, 50-cycle water-wheel alternators are designed to generate 13,333 kVA when running at a speed of 428 r.p.m., and at the time of our visit to the works they were erected on the test plate, as shown in the illustration. The high-voltage motor generator set, which is the fourth machine of the kind the B.T.H. Company has built for the Rugby radio station, consists of five machines mounted on an insulated bed-plate, the high-pressure D.C. being provided by two 6000-volt, single-commutator generators, connected in series, and under working conditions the set may be connected in series with one of the existing 6000-volt D.C. generators, so as to give a maximum working pressure of 18,000 volts to earth. The control and protective gear, which is mounted on a separate insulated bed-plate, is operated through insulated coupling from outside an enclosure which serves to enclose the complete unit, the only metallic connections between the interior and exterior of this enclosure being the high-voltage D.C. feeder and the A.C. feeder to the synchronous motor, which, like the secondary winding of the supply transformer, is insulated for a test pressure of 50,000 volts to earth for one minute. The frequency changer which consists of a 6050-kVA, 750 r.p.m., 25-cycle, 5500-volt, three-phase synchronous motor coupled to a 7470-kVA, 50-cycle, 5500-volt, three-phase alternator, is to be installed in the Smethwick power station of the Shropshire, Worcestershire, and Staffordshire Electric Power Company.

For the tube sections of the London Underground Railways the company is constructing 145 sets of relay automatic electro-magnetic control equipments and eight similar equipments for the Metropolitan District Railway. Many control equipments are also in the course of manufacture for trolley omnibuses. Although at the moment there is not a large amount of ship propulsion plant in the shops, the turbo propulsion equipments for the P. and O. Company's 28,000 H.P. liners "Strathnaver" and "Strathaird" have recently been completed. Another of the company's jobs is that of constructing the turbo-electric propulsion equipment for the Union Steamship's passenger vessel "Rangatira," which will ply between Wellington and Lyttleton.

IRON AND STEEL INSTITUTE.—By invitation of the Council of the Iron and Steel Institute, Viscount Ednam, chairman of the Earl of Dudley's Round Oak Works, Ltd., and Mr. Robert S. Hilton, managing director of the United Steel Companies, Ltd., have accepted seats on the Council. The Council has also elected the eminent metallurgist, Geheimrat Professor Fritz Wüst, late Director of the Kaiser-Wilhelm Iron Research Institute at Düsseldorf, to be an honorary member of the Institute.

Irrigation Research Work in the Punjab.

THE practice of irrigation engineering in India, as elsewhere, has hitherto been based mainly upon accumulated and compared experience, studies and experiments carried out, often under great difficulties, by individuals and directed to the interpretation of natural laws, and departmental experiments intended, primarily, to throw light upon the methods to be followed in specific cases of design.

In the Punjab it was realised some years ago that the time had come when the practice of the art of irrigation in all its aspects should be aided by organised research. The appointment in 1924 of Mr. B. H. Wilsdon, as Scientific Research Officer in the Irrigation Branch of the Public Works Department was the first step taken giving effect to Sir Thomas Ward's recommendation in 1915 that a trained physicist should be appointed to undertake research work in connection with various projects. In 1925 a Waterlogging Inquiry Committee of two members was appointed. As a result of the creation in 1928 of a provincial Waterlogging Board, that Committee was abolished, its staff being absorbed by the Irrigation Branch and distributed between the Scientific Research Officer and the Superintending Engineer of the Waterlogging Investigation Circle.

An account of this initiation of irrigation research, the stage to which it has advanced, and proposals for its development is given in a "*Note on the Proposed Development of Scientific Research in the Irrigation Branch, Public Works Department, Punjab*," by Mr. E. McKenzie Taylor, Scientific Research Officer, Irrigation Research Division, Lahore, dated April 4th, 1931, from which the following notes are taken.

RESEARCH.

The staff normally employed at the present time, apart from the gazetting of certain posts, is substantially that of December, 1928, namely:—Five gazetted officers: Scientific research, mathematical, and statistical, and two assistant research officers. Non-gazetted staff: Four junior research assistants, one sub-overseer, eight computors, four muqaddams, one mechanical driver, two mistris, one fitter, two gauge inspectors, laboratory attendant, storekeeper, draughtsman, accountant head clerk, six clerks. One of the assistant officers is a physicist and the other a soil chemist and agriculturist.

The laboratory is provided with a supply of water, gas, and electricity, and includes well-equipped chemical and physical laboratories, a workshop with three lathes and a drilling machine, and a hydraulic laboratory with a 60ft. glass-sided flume. A circulating supply up to 5 cusecs is delivered to the flume by a battery of motor-driven centrifugal pumps, while facilities are provided for direct volumetric measurement as well as for continuous measurement by Venturi meters.

The Chakanwali Farm, situated alongside the main line of the Lower Chenab Canal and some 20 miles from its headworks at Khanki, has an area of about 3600 acres. It was acquired in May, 1926, for the purpose of carrying out experiments on the reclamation of waterlogged and alkaline lands of which it mainly consisted.

Including, in the second to the fifth years, relatively small contributions from the revenue department, the funds allotted by the Irrigation Department for this work were:—1924–25 to 1929–30: Rs. 30,800, Rs. 53,200, Rs. 2,08,700, Rs. 4,17,900, Rs. 2,91,000, Rs. 1,97,300. During the six years the apportionment of this expenditure per cent. was:—Establishment and work in the laboratory, 28·9; waterlogging investigations, 11·3; reclamation work at the farm, 40·6; suspense, 3·1; laboratory buildings and equipment, 16·1.

As an offset to the third item above, the farm has yielded during the period in rent and produce a direct revenue of about Rs. 1,33,000, which takes no account of the appreciation in value of some 640 acres of reclaimed land.

Virtually, the work has been carried out under three sections—mathematical, statistical, soil chemistry and agricultural physics.

Of interest to irrigation engineers and administrators in all irrigation regions, the following brief indications of the nature of some of the more important researches carried out are quoted from the "Note."

Mathematical.—Treatment of problems connected with subsoil flow from open channels and into wells, and the determination, from actual observations on wells, of the value of the transmission constant of soils.

Torsion balance survey of the submerged rock barrier traversing the Rechna and Chajh Doabs of the Punjab.

Statistical.—Determination for several of the perennial canal systems of the Punjab of regression curves, giving the relation between the time-distribution of water applied to land—as rainfall and irrigation—and the rate of rise of the subsoil water table. Application of such regression curves to predict the effect of changes in the application of irrigation water.

Analysis of the results of watercourse experiments with a view to determine the extent and distribution of wastage of water in normal irrigation practice.

Investigation of the relations between the discharges of the river Indus at Sukhur and the discharges at upstream sites.

Soil Chemistry and Agricultural.—Investigation of the osmotic forces of soils.

Study of the efflorescence of salts from brickwork and of methods of its prevention.

Reclamation of waterlogged land by open and subsoil drainage and its cultivation by steam tackle and tractor.

Reclamation of alkaline land by leaching and treatment with gypsum and green manures.

Physics.—Investigation of the hydrostatic pressure of soil water under conditions of partial saturation.

Determination of the hydrogen on concentration of soil extracts and suspensions by means of the glass electrode apparatus.

Grading of river and canal-borne silts by a new method involving the continuous photographic record of minute changes of pressure in a manometer.

Installation at numerous canal stations of a new type of instrument, devised in the laboratory, for measuring the

evaporation from all causes from the surface of a porous pot exposed to sun and wind.

Application of a conducto-metric method to the analysis by titration of waters and soils extracts.

IRRIGATION RESEARCH.

While the work carried out during the last six years by the Research Division in the laboratory and in the field has added materially to an understanding of fundamental principles, and has elucidated many of the factors involved in the process of soil deterioration in irrigated tracts, it has yet to find an economic solution of such problems as the prevention or cure of progressive salinity of soils with a rising water table, or the treatment of unproductive alkaline soils so as to render and maintain them fertile. The pressing need, in view of the increasing seriousness of these problems, and of the vast interests at stake, of intensified research on a much wider scale than hitherto attempted has now been recognised by the Punjab Government.

Under the orders of Government, a scheme based on Mr. Calvert's proposals was recently formulated for developing the existing research laboratory into an Irrigation Research Institute of greatly increased scope and strength. Measures are being taken to put into effect this scheme, for a five years' programme of gradual expansion, culminating in the establishment of five research sections and a central section, with an annual expenditure of about Rs. 6,75,000.

The additional expenditure to be faced in the next five years is about Rs. 13,20,000, and it is hoped that the Imperial Council of Agricultural Research may contribute about half that sum. The schedule of the proposed establishment provides for forty-nine persons in the central section and in the other sections—irrigation and engineering, 26; mathematical and hydraulic, 12; physical, 6; soil, 18; agricultural, 10.

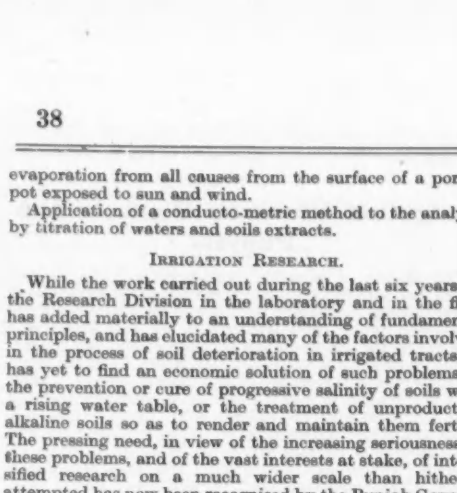
Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

LEWIN LOCOMOTIVES.

SIR,—The town of Poole, Dorset, has an unfamiliar ring as a locomotive constructional centre, and while it may be a matter of common knowledge that some few locomotives were at one time built there by Mr. Stephen Lewin—it is probably less well known that one, at least, exists at the present time. An account of some of his locomotives can be found in Mr. A. R. Bennett's book, entitled "The Chronicles of Boulton's Siding," together with the very apt remark that Mr. Lewin ran his works "more as a hobby than for profit."

These locomotives were of the small shunting tank variety, both narrow and standard gauge, and as examples



A LEWIN LOCOMOTIVE

of ingenuity and uniqueness of design, are to be highly commended, although, from the engineering standpoint, they leave much to be desired, and remind one more of the early days when peculiarities of appearance and design were part of the necessary development of the locomotive. The outstanding feature is, undoubtedly, the inclination of the cylinders, which, in the locomotive under review, is as much as 20 deg. The small boiler and low smoke-box bring the cylinders almost flush with the chimney base, besides which their size is almost as large as that of the smoke-box itself.

The locomotive referred to is a standard gauge 0–4–0 T, and is owned by my company, being attached to their Durham Works at Haverton Hill.

The upper photograph shows the locomotive as originally constructed and leaving Poole in July, 1875, for our Cheshire Amalgamated Works—which became the property of the Salt Union Ltd., in 1888—and has been very kindly supplied by the Locomotive Publishing Company.

The lower photograph shows the same locomotive as it now is, and although various modifications have been introduced—including the change of name—the general appearance is unaltered and the identity is readily detected. The cylinders are 10in. diameter and 18in. stroke, wheels 3ft. and working pressure 120 lb. The original boiler did not last very long, and was renewed in 1881. After working at Winsford until 1907, it was transferred to the Durham district, where it has been working continuously ever since.

The number of locomotives constructed by Mr. Lewin is extremely limited—possibly not more than twenty all told—and in view of their peculiarities, both of engineering practice and of general appearance, I trust I may be excused in bringing the existence of this locomotive to the attention of your readers, especially in view of the fact that the engine is still doing good work after 56 years, and still retains its somewhat primitive appearance.

Some of these locomotives are believed to have gone to the Isle of Man and some to Dublin, and it would be interesting to ascertain the original destination of any other of the Lewin engines, and particularly the present whereabouts, if any are still in existence.

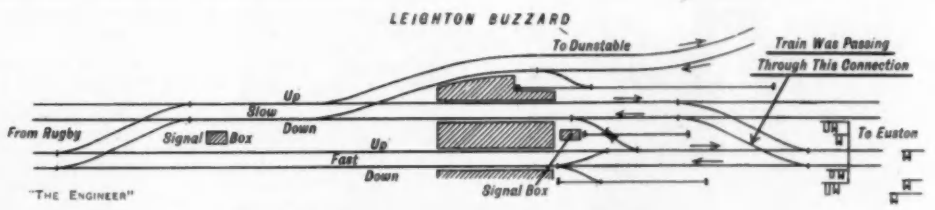
As a further illustration of complicated design, some examples are recorded, where the excentrics were on the front coupled axle, thus rendering it impossible to use the engine without the side rods. Such an engine found its way to Boulton's locomotive yard at Ashton-under-Lyne very quickly, but another is thought to still survive at Swanscombe, Kent.

The activities of the firm of Stephen Lewin as locomotive builders have long since ceased, but the name "Stephen Lewin" can still be faintly discerned on the building, that in the 1870's saw the construction of these interesting little engines.

For the SALT UNION, LTD.,
S. T. T. GEABY,
Works Manager (Worcestershire District).
Stoke Prior, July 3rd.

The Leighton Buzzard Fatal Derailment.

THE accompanying diagram, reproduced from our issue of April 3rd, shows the site of the fatal derailment at Leighton Buzzard on Sunday, March 22nd. In that case the 11.30 a.m. express from Euston to Glasgow and Edinburgh had to be diverted from the down fast to the down slow line, an operation that called for a reduction of speed to 20 m.p.h. To secure that reduction the signalman in No. 1 box—the nearer of the two signal-boxes to London—was instructed to keep his home signals, and therefore his distant signals, at the "on" indication until the speed of any train that had to cross had been reduced. There is ample evidence that the signals in question were against the



SITE OF THE LEIGHTON BUZZARD DERAILMENT

express, but they were ignored and the train ran through the connection at such a high speed that the engine and tender overturned, the next three coaches were destroyed, and the fourth very badly damaged. Three passengers, together with the driver, fireman and a restaurant car cook, were killed.

The accident was inquired into by Lieut.-Colonel Mount, accompanied by Mr. Scott Main and Lieut.-Colonel Woodhouse. Colonel Mount, in his report issued on July 6th, arrives at the conclusion that "the cause of this regrettable accident was the failure on the part of the enginemen to obey the signal indications." The fact, however, that both men were killed renders impossible direct evidence in regard to the circumstances in which this took place, and what happened on the footplate must remain a matter of surmise. Most of the contingencies that might have arisen there to distract the men's attention can be eliminated as a result of the subsequent examination of the locomotive. One or other of the men may have been taken with sudden illness and needed assistance. Against that there was evidence that both men were seemingly in their usual health when they left Euston. There was the possibility of actual diversion of attention, owing to conversation on the footplate following some minor incident in the working of the engine or otherwise. There might have been some difficulty with the fire, examination of which may have momentarily affected the eyesight. Grit in the eye may have needed the fireman Rogers' assistance, or failure of an injector the assistance of driver Hudson. Or again, it would not be an unreasonable explanation for conversation and diversion of attention had the brick arch, or part of it, failed. It was found to be destroyed after the accident, but that may have been a result of the derailment.

Then there is the question of obstruction of the driver's view by steam and smoke beating down on the cab window. Though the wind was from a westerly direction at the time, it was probably not of sufficient velocity to preclude this possibility, having regard to the speed of the train and the fact that the engine was steaming lightly on a falling gradient. But, as Mr. Anderson, the superintendent of motive power, said, Hudson was a man who knew "every inch" of the road, and, as the distant signals are located in the only cutting in this neighbourhood, it is very difficult to believe that, on a fine day, even though his view of the signals may have been temporarily obscured, he could have remained for nearly a minute under the wrong impression that he was still approaching them, *i.e.*, that he had not passed the distants. There is no doubt, however, Colonel Mount remarks, that "Royal Scot" engines suffer from this disadvantage, and though, in consequence, a driver would take precautions accordingly, and this feature has not, he understands, had untoward results, it may be that, on this occasion, change of direction of the train on the curve—an easy right-handed curve of a radius varying between 3 and 4 miles—accentuated the difficulty of vision. Colonel Mount feels that this is not a contingency which can be entirely disregarded; for instance, it is conceivable that it may have contributed to misreading of the distant signal indication.

One other factor calls for attention. It relates to an intimation in the "Fortnightly Notice" that, because of engineering operations, all trains on the down fast line would be diverted on to the down slow line at Leighton Buzzard from 2.30 p.m. to 5 p.m. on the day in question; also that all down fast trains would be diverted on to the down slow line at Tring—nearer London—from 7.30 a.m. to 2 p.m. Both movements were changed; the latter was cancelled and the former was put forward to be made between 7.30 a.m. and 2 p.m. A special notice as to this was issued, but driver Hudson was not given one and the guard of the train failed to read it. Colonel Mount proceeds to observe that none of the above and similar explanations can, however, "be regarded as conclusive, and there is the further contingency of psychological failure, namely, lapse or mind-wandering, following momentary lack of concentration. In this connection the question arises as to Hudson's knowledge, or rather his ignorance, that the train was to be diverted. . . . I feel that had he seen this Notice, and thus been aware of the routing of his train, the need for special alertness when approaching Leighton Buzzard would have been impressed upon his mind and the accident might thereby have been averted, assuming that he was not incapacitated before it took place. . . . It is hardly necessary though, to add that a driver's first duty is to run to signal indications, for failure in that respect neutralises all safeguards."

Colonel Mount concludes his report thus:—"It is difficult to imagine a better illustration in support of the conclusions of the recent Committee upon Automatic Train Control. Had equipment of this kind existed, operating in conjunction with the distant signal, I think that this accident would have been prevented.

"In the absence of such direct means for assisting enginemen in their duties, every endeavour should be made to reduce the liability of obstruction of vision from the footplate, and the Committee also specifically referred to this point. The driver, when sitting on the left-hand side of the cab of the 'Royal Scot' class engine, obtains a good view of the road ahead through a rectangular window of ample dimensions. But the high boiler pressure renders it possible to run with an early cut-off, even with a heavy train, and this results in a comparatively gentle beat, which, coupled with an exceptionally large smoke-box volume, accentuates the liability for steam and smoke to drift along the top of the boiler, particularly when working lightly.

"This feature is noticeable on this class of engine, and it is recognised, and has been considered, by the company's officers. But improvement, I understand, has not yet passed beyond the stage of experiment with various forms of baffle plate round the chimney. Like the lip of the chimney itself, however, this does not appear to be effective, at any rate when running in steam. Nor does the operation of the blower, when running without steam, seem to improve matters. I recommend, therefore, that steps be taken forthwith to test thoroughly the arrangement of 'down-draught' plates at the side of the smoke-box, which have undoubtedly been found for some years to be efficacious on the Southern Railway and on the Continent.

"In this connection, the Chief Mechanical Engineer informed me that wind tunnel experiments with a model are being undertaken, such as those which apparently resulted in the successful design of engine 'No. 10,000' on the London and North-Eastern Railway. Having regard to the size of the smoke-box of the 'Royal Scot' class, it would not seem to be inappropriate also to consider alteration of the front on similar lines.

"It remains to add that I am informed that necessary steps have been taken to ensure compliance with the procedure laid down for the issue of Fortnightly and Special Notices to drivers. Obviously the same procedure should apply to both; otherwise information previously given may be definitely misleading if the men are not aware of its subsequent cancellation. In my opinion, guards should similarly receive, and sign for, all Special Notices, and there would appear to be an advantage in the exchange, between guard and driver, of information as to routing, if and when they have occasion to speak to one another before departure, in connection with their other duties."

A PUBLICATION, compact and comprehensive, is issued every year by our Government, under the title of the "Guide to Current Official Statistics." This contains, in addition to a list of the statistical volumes issued by each Government Department, a systematic index of their contents arranged alphabetically according to subject, with statements of the degree of detail in which the subject is treated and the time and place to which the statistics relate. Directions for using the guide to the fullest advantage are given in an explanatory introduction. By following them the inquirer is enabled to discover in a few minutes exactly what official statistics relating to his subject are available, and the names and prices of the publications in which they are to be found. Vol. IX. of the guide—price 1s. net, post free 1s. 5d., pp. 319—has just been issued, and may be obtained direct from the sale offices of H.M. Stationery Office, or through any bookseller.

Railway and Road Matters.

THE new general railway station in Milan was formally opened on July 1st. It has twenty-two platforms, and the station in Leipzig is the only one on the Continent that exceeds it in size.

THE reports to the Ministry of Transport, both by Lieut.-Colonel Mount, on the fatal derailments at Carlisle on January 3rd and at Leighton Buzzard on March 22nd, were issued on July 1st and 6th respectively.

LIKE all railway systems the world over, those in India are having to retrench, and towards that end men are being discharged. That, according to a telegram in *The Times* of July 3rd, is likely to give trouble, and the All-India Railwaymen's Federation proposes to issue a general strike ballot on August 1st.

THE handling of the traffic of the "Underground" system of London, whereon our files show that 500 million passengers are carried yearly, is the envy and admiration of every rapid transport concern in the world. A new record was set up by the number of passengers who used the Underground Railways for the Air Pageant at Hendon on Saturday, June 27th; 108,000 arrived at Colindale Station alone during the day, or 10,000 more than last year, and the highest number ever handled at any Underground station on one day. If allowance is made for the number of people arriving at Hendon and Burnt Oak stations for the pageant, the total number of those travelling in the two directions would be not less than a quarter of a million.

THE Mechanical Department of the South African Railways and Harbours, with extensive workshops scattered through the four provinces, employs a staff numbering over 10,000 and controls an expenditure exceeding £3,000,000 a year on the maintenance of rolling stock. In addition to this, a sum totalling over £1,000,000 is spent annually by the Transportation Department on running repairs. In 1910 approximately 6800 employees were distributed throughout the shops. The number of passenger coaches sent in for repair during 1930–31 totalled 3737, an increase of 1212 over those dealt with during 1910–11, while 85 were built and 16 erected in the workshops during the twelve months ended March 31st last.

THE various obituary notices we have seen of Sir William Hart Dyke, who died on July 3rd, have been so full of the many interesting political incidents in his long life that it apparently has escaped notice that from 1911 to the formation of the Southern Railway at the end of 1922, Sir William was chairman of the London, Chatham and Dover Railway. It is perhaps necessary in these later years to explain that whilst there was, as from the end of 1898, a fusion between the South-Eastern and the London, Chatham and Dover, each company maintained a separate existence, with its own board of directors and chairman. The combined interests of the two companies were administered by a South-Eastern and Chatham Managing Committee, which again had its own board and chairman.

TWO very interesting points in transport law have just been decided. The first arose in Carlisle where the Corporation sought licences from the Northern Area Traffic Commissioners to run a municipal motor omnibus service in the city. The tramways in Carlisle are owned and operated by a private company, and the Corporation has itself no operating powers to run either trams or omnibuses. The licences were consequently refused. The other case comes from Luton, where the Corporation wished to sell the tramways to an omnibus company and to enter into an agreement not to have any competitive service with the omnibus company for twenty-five years. The Minister of Transport has refused his consent to the scheme on the ground that it would be contrary to the Tramways Act, 1870.

GANGERS inspect their lengths once a day, but apparently since 1925 the London and North-Eastern has ceased to have the branch lines in its north-eastern area inspected on Sundays. This change led to a question being addressed recently to the Minister of Transport, who was asked to take up the question with the railway company, "in view of the danger of accident being caused through this lack of inspection." Mr. Morrison replied that the responsibility for the proper and safe maintenance of the permanent way rests entirely with the railway company, over which, in regard to that matter, he had no control. The railway company's officers stated that they were advised by their responsible engineer that the arrangements were adequate, and he saw no reason to question their view.

THE comments made under "Sixty Years Ago" in THE ENGINEER of July 3rd as to the opening of a section of railway in which the Metropolitan and Metropolitan District Railways were concerned, prompts us to add that the occasion was the extension on July 3rd, 1871, of the District Railway from Blackfriars to Mansion House, and the provision of separate lines for the District trains between Cromwell Curve, through Gloucester-road, and South Kensington stations, and the east end of the latter. The Metropolitan Railway proper had been opened from Praed-street Junction to Gloucester-road on October 1st, 1868, and the District Railway commenced at the latter point, and its line was opened to Westminster Bridge on December 24th, 1868; to Blackfriars on May 30th, 1870; and, as said above, completed to Mansion House on July 3rd, 1871. On the Praed-street–Gloucester-road line there is, as all know, Kensington, High-street. It is jointly owned by the Metropolitan and Metropolitan District companies, and thence is a District-owned line to Earl's Court. It and an extension in a south-westerly direction to West Brompton, were opened on April 12th, 1869, also an extension in a north-westerly direction from Earl's Court to near Addison-road on the West London Extension Railway. The base, or south side, of Cromwell Curve was brought into use on September 9th, 1874, and District trains commenced then to run westwards of Gloucester-road. The junction between the two companies is at a point 5 chains east of South Kensington Station, and the Metropolitan uses the northern lines and the District uses the southern.

Notes and Memoranda.

AT the new sulphuric acid works of the Merrimac Chemical Company, of Everett, Massachusetts, where a vanadium catalyst is used in the place of platinum, the floor space of the buildings has been reduced from 1000 square feet per ton of sulphur treated per day down to 112 square feet per ton.

IN a paper read before the South Staffordshire and Warwickshire Institute of Mining Engineers, Mr. T. G. Bocking suggested that as things stand at present about 70ft. of overburden is the economic limit for opencast ironstone mining. He said, however, that he did not know of more than 45ft. of cover being removed in one lift.

SAN FRANCISCO has 40 telephones for every 100 people, Washington 33, Denver and Seattle 32. Stockholm and Los Angeles are only a fraction behind the 32 mark. Then follow Chicago, Omaha, Toronto, Minneapolis, New York, Pittsburgh, Montreal, Oslo, Copenhagen, and Zürich. Paris has 12·5 telephones per 100 people. London has only 8·7.

IN designing the great chimney of the Copper Cliff smelter in Ontario, which is 510ft. high and 45ft. inside diameter at the top, wind pressures were calculated at the rate of 27½ lb. per square foot for a wind having a velocity of 110 miles per hour. The chimney is 73ft. in diameter and 4ft. 6in. thick at the bottom, and 17in. thick, not including the lining, at the top.

THE consumption of copper for the transmission and distribution of electric current reached a new high record of approximately 260,000,000 lb. in 1930, according to figures presented in a survey of the electric light and power industry of the United States, just completed by the Copper and Brass Research Association. This represents an increase of more than 330 per cent. in annual use of copper by power companies since 1920.

AN anti-corrosive alloy which has been named Batterium Metal, and is being produced by a company at Market Harborough, is a natural alloy of copper 89 per cent., aluminium 9 per cent., nickel 2 per cent. and some minor additions. It has a melting point of 1035 deg. Cent. and a tensile strength of from 35 to 45 tons per square inch. It appears to be more resistant to corrosion than the steels of the stainless type.

BECAUSE of its high fusing point—about 3000 deg. Cent.—zirconia is one of the most refractory oxides known. It does not melt below 2560 deg. Cent., even when it contains approximately 1·25 per cent. of silica and ferric oxide. The pure fused material has very low thermal conductivity and a very low coefficient of expansion—8·4 times 10^{-7}—which compares favourably with that of carborundum—6·58 times 10^{-6}—or alundum—7·1 times 10^{-6}. Zirconia withstands sudden changes of temperature remarkably well, and it is chemically inert, being highly resistant to acids, fused quartz, and molten glass, and, to a large extent, even to fused alkalies. Under certain conditions, however, it has a tendency to be changed at high temperatures into a nitride or a carbide.

ONE of the minor problems in connection with the Birmingham Tame and Rea District drainage works has been that of maintaining the 8ft. diameter conduit in a clean condition. Cleaning operations by manual labour proved, according to Mr. H. C. Whitehead, costly, and could only be carried out at rare intervals. A method has been evolved whereby the work is done cheaply and efficiently by means of a 7ft. diameter wooden ball or "sewer pill." This ball is dropped into the conduit at Saltley, and, being buoyant, rolls along the arch of the conduit. The obstruction to flow which it causes produces a vigorous scouring action along the invert and sides of the conduit, which has the effect of removing growths and deposits from the sewer. At the end of its journey the ball is hoisted out of the conduit and returned by motor lorry to Saltley. This method of cleansing is resorted to at frequent intervals.

A DEVICE by means of which everything said by both parties concerned in a telephone conversation is recorded on a magnetic steel wire in such a manner that it can be reproduced at any subsequent time, is an advance in communications technique announced by the International Telephone and Telegraph Corporation. The record so obtained can be preserved as long as may be required, but it is also possible to obliterate the message so that the wire can used over and over again. By reason of the recent association with the International System of the Echophon Maschinen A.G., of Berlin, which has been furthering the development of this device, it is now possible to place this conversation recorder at the disposal of telephone users, and thus greatly increase the usefulness of the telephone in all countries in which the International System operates telephones or provides communication equipment. One of the important applications of the conversation recorder is in connection with long-distance cable and radio telephone calls.

COPPER harder than structural steel has, it is announced in America, been produced in the laboratories of the Montana School of Mines by a comparative simple heat treatment. Though it was general knowledge among the mining men that researchers had been working for the past year on the development of hard copper, this was the first time that an official paper on the process was read. The research work was carried out under the supervision of Dr. Francis A. Thompson, President, and Dr. L. Wilson, head of the Metallurgy Department. Speaking before the Montana section of the Institute of American Mining Metallurgical Engineers, H. F. Sillimans, of Waterbury, Conn., a research fellow in metallurgy, gave a detailed account of the latest contribution to the copper hardening problem. For a number of years it has been known that additions of small portions of nickel and silicon to copper produced an alloy which would respond to heat treatment. But, Sillimans said, the wildest dreams of researchers were exceeded when copper was developed with a tensile strength of more than 100,000 lb. to the square inch and a hardness one and one-quarter times that of structural steel.

Miscellanea.

THE date of the opening of the Leipzig Autumn Fair this year is August 30th.

THE work of extending the dry dock at Genoa has now been finished. It is 260 m. long.

WIRELESS communication is about to be established between New York and Mukden.

FOUR new electrical apparatus factories have been started in Toronto by United States firms.

A SWEDISH engineer, J. F. Hagerup, is surveying Siam to determine the water power resources of the country.

IT is expected that the new 2,500,000 bushel grain elevator at Churchill, Hudson Bay, will be ready to handle shipments of grain to Europe this year.

WORK has been restarted on the hydro-electric power plant of the Portland Canal Power Company, in South-Eastern Alaska. It is to have a capacity of 40,000 horse-power.

IN order to develop the cassérite, tin, deposits of Katanga, Congo, a hydro-electric plant of 15,000 horse-power is to be constructed on the Luvua River some 30 kiloms. above Kiambi.

A COMPANY has been formed in Stockholm for the development of the Flodin system of producing iron and steel directly from the ore. Works are to be put up at Larvik in Norway.

IT is estimated that the cost of starting the new iron and steel works at Pretoria, South Africa, will be approximately 5½ millions. The output is intended to be some 150,000 tons of steel a year.

A PLANT for the manufacture of cyanimide is to be put up at Duginot, near Split, in Jugo-Slavia. It is to have a capacity of 60,000 tons a year, which will provide a margin over the native needs for export.

A BILL is to be submitted to the Argentine Congress recommending construction of a hydro-electric plant in the province of Tucumán. This includes two 10,000 H.P. stations and an irrigation dam on the Rio Sali, and a 10,000 H.P. plant on the Rio Marapá. The town of Rio Cuartohas has applied to the Provincial Legislature for the installation of a hydro-electric plant.

THE telephones of the world increased by three-quarters of a million during 1930. The total number of telephones on January 1st, 1931, was 35,300,000, and of them North America had 21,695,375, or 62·84 per cent. Europe had 10,035,580, or 29·07 per cent. Asia came third with 1,201,008—3·48 per cent.—Oceana fourth, and South America fifth. Africa, with only 236,108, or 0·68 of the world's total, was the least developed from a telephone point of view.

WE are asked by the Institution of Electrical Engineers to announce that the annual conversazione this year will be held at the Royal Albert Hall on Tuesday evening, September 22nd, and that the Summer Meeting, for which an extensive programme of visits has been arranged, will take place in London from Tuesday, September 22nd, to Friday, September 25th, the programme concluding with a ball at Grosvenor House, Park-lane. Members interested in the Summer Meeting should apply without delay to the Secretary for particulars.

MORE than 21,000 acres was planted with trees in the American national forests in the calendar year 1930, according to a compilation of field reports just completed at the Washington headquarters of the U.S. Forest Service. The acreage planted has been increased gradually from the low point of 5500 acres in 1921, as the result of small increases in funds made available by Congress and of improvements in planting technique. Forest officers believe that 25,000 acres is not too much to expect for 1931. Larger-scale operations and improved methods have made possible a reduction in the unit cost of planting.

IT is announced from Paris that the French Chamber has adopted a scheme for the installation of an electric voting apparatus. By it, each Deputy will press a button on his desk representing "For," "Against," or "Abstention," and a corresponding metal token bearing the Deputy's name will fall into a box with three compartments placed in the Chamber. The tokens are to be weighed and the number in each department be thus ascertained. It is asserted that by this means, which is to come into operation in the next session of the Chamber, the divisions will be both accurately and rapidly recorded.

THE whole of the Historical Pageant of Bradford, which will be opened by Prince George on July 13th, and in which 7500 performers will take part, will be directed by telephone. More than 8 miles of telephone cable have been laid in Peel Park, where the Pageant is to be held. Seven telephone control boxes, all in direct communication with a master control box, have been installed at the various performers' entrances, while loud-speaker telephones have been placed at various points to facilitate control of the spectators. The Pageant producer, by pressing a key in the master box, can immediately get into touch with any of the control points.

SOME months ago the Swedish Government purchased a number of "Bristol" Bulldog single-seater fighters, fitted with "Bristol" Jupiter Series VII.F. supercharged engines, with the intention of submitting them to thorough tests over an extended period before committing itself to the choice of this type for the general equipment of the Swedish Air Force. These trials included service throughout a rigorous Swedish winter. So satisfied were the Swedish authorities with the results obtained that they recently placed an order with the Bristol Aeroplane Company, Ltd., for the supply of eight further "Bristol" Bulldogs. These machines have now been completed and have fulfilled a series of performance tests in Bristol to the full satisfaction of a Swedish Acceptance Commission. The machines were then flown to Sweden by pilots of the Swedish Air Force, in two flights of four machines each. It is of interest to note that the "Bristol" Bulldog to-day forms a standard single-seater fighter for no less than four of the countries washed by the Baltic.

THE YALLOURN LIGNITE ELECTRIC GENERATING STATION

(For description see page 28)

FIG. 3—OVERBURDEN DREDGER IN OPERATION

FIG. 4—BRIQUETTING FACTORY AND CABLE HAULAGE-WAY

FIG. 5—LIGNITE DREDGER AT WORK

FIG. 6—RAIL SHIFTING MACHINE FOR DREDGER

The Engineer

Annual Subscription Rates

(Including postal charges).

Subscriptions will be accepted by the Publisher direct or through a newsagent at the rates and in the currencies stated below :—

BRITISH ISLES	£3	5	0	
CANADA	£3	3	0	Thick Paper edition.
	£2	18	6	Thin Paper edition.
ABROAD	£3	7	6	Thick Paper edition.
(except Canada)	£3	3	0	Thin Paper edition.

AFRICA	Central News Agency. All Branches
* £3 7s. 6d.	CAPE TOWN : Wm. Dawson and Sons, Ltd.,
† £3 3s. 0d.	29–31, Long-street (Box 489)
	JOHANNESBURG : C. Juta and Co.
ARGENTINE	BUENOS AIRES : Mitchell's Book Store, 576,
* £3 7s. 6d.	Cangallo
† £3 3s. 0d.	
AUSTRALIA	Gordon and Gotch (Australasia), Ltd. All
* £3 7s. 6d.	Branches
† £3 3s. 0d.	MELBOURNE : Robertson and Mullens,
	Elizabeth-street
BELGIUM	BRUXELLES : E. Graddon, 78, Rue du
* Fr. 590	Marché-aux-Herbes
† Fr. 550	BRUXELLES : W. H. Smith and Son, 78–80,
	Rue du Marché-aux-Herbes
CANADA	American News Company, Ltd. All Branches
* $15·25	MONTREAL : Gordon and Gotch, Ltd., 334,
† $14·25	Notre Dame-street, W.
	TORONTO : Wm. Dawson and Sons, Ltd., 87,
	Queen-street East
	TORONTO : Gordon and Gotch, Ltd., 81,
	Queen-street West
CEYLON	COLOMBO : Wijayartna and Co.
* Rs. 44·5	
† Rs. 41·5	
CHINA	HONG KONG : Kelly and Walsh, Ltd.
* $37	SHANGHAI : Kelly and Walsh, Ltd.
† $34·5	
EGYPT	CAIRO : Express Book and Stationery Store,
* £3 7s. 6d. (Pt. 330)	9, Chareh Maghrabi
† £3 3s. 0d. (Pt. 308)	
FINLAND	HELSINGFORS : Akademiska Bokhandeln,
* M. 650	Alexandersgatan, 7
† M. 605	
FRANCE	PARIS : Boyveau and Chevillet, Rue de la
* Fr. 418	Banque, 22
† Fr. 390	PARIS : Librarie Berger-Leverault, 229, Bld.
	St. Germain
	PARIS : Brentano's, 37, Av. de l'Opera
	PARIS : Dunod, 92, Rue Bonaparte
	PARIS : W. H. Smith and Son, 248, Rue de
	Rivoli
GERMANY	BERLIN–LICHTERFELDE–WEST : H. Her-
* R. mks. 70·00	manns, Dahlemer Strasse 64 A
† R. mks. 65·00	LEIPZIG : K. W. Hiersemann, Konigstrasse 29
HOLLAND	ROTTERDAM : Hector's Boekhandel, Noord-
* Fl. 41·00	blaak 59
† Fl. 38·00	ROTTERDAM : Techn. Boekhandel, "Plan C,"
	Gelderschestraat 4
INDIA	BOMBAY : Thacker and Co., Ltd.
* Rs. 45	CALCUTTA : Thacker, Spink and Co.
† Rs. 42	
ITALY	MILAN : Ulrico Hoepli
* Lire 300	ROME : Maglioni and Strini, 307, Corso
† Lire 280	ROME : Fratelli Treves, Corso Umberto 1, 174
	ROME : Fratelli Bocca
	TURIN : Rosenberg and Sellier, v. Maria
	Vittoria 18, and their Branches at Naples
	and Rome
JAPAN	Maruzen Co. All Branches
* £3 7s. 6d.	
† £3 3s. 0d.	
JAMAICA	KINGSTON : Educational Supply Co.
* £3 7s. 6d.	
† £3 3s. 0d.	
NEW ZEALAND	AUCKLAND : Whitcombe and Tombs, Ltd.
* £3 7s. 6d.	Gordon and Gotch, Ltd. All Branches
† £3 3s. 0d.	NAPIER : J. Wilson Craig and Co.
RUSSIA	LENINGRAD : Mezhdunarodnaya Kniga, Pros-
* £3 7s. 6d.	pect Volodarsky, 53 A
† £3 3s. 0d.	MOSCOW : "Litisdat," Kousnetsky Most, 5-15
STRAITS SETTLEMENTS	SINGAPORE : Kelly and Walsh,
* $29·25	Ltd.
† $27·25	
SWEDEN	STOCKHOLM : A/B Wennergrens Journal-
* Kr. 61·00	expedition, Stockholm 1
† Kr. 57·00	STOCKHOLM : A/B C. E. Fritzes Kungl.,
	Hofbokhandel, Fredsgatan, 2
SWITZERLAND	BERNE : Joh. William De Groot, Laupenstr. 5
* Fr. 85·20	ZURICH : Rosa Leibowicz, 4, Ankerstr.
† Fr. 79·50	
UNITED STATES OF AMERICA	International News Co., 131, Varick-street, New York, N.Y., and all Branches
* $16·40	Entered as second-class matter at the Post Office,
† $15·25	New York, N.Y., December 12th, 1896, under the Act of March 3rd, 1879 (Section 397, P.L. & R.)

* *Thick Paper.* † *Thin Paper.*

These rates are liable to alteration if exchange fluctuations require it.

*** READING CASES, *to hold two copies of* THE ENGINEER, *cloth sides and leather backs, can now be supplied at 4s. 9d. each, 5s. 3d. post free.*

"THE METALLURGIST."

This Supplement, which deals with the Science and Practice of Metallurgy, both ferrous and non-ferrous, is published free with the last issue of THE ENGINEER in each calendar month.

ADVERTISEMENTS.

The charge for Classified Advertisements is 1/- per line up to one inch—minimum charge 4/-; those occupying one inch or more at the rate of 12/- per inch. Orders must be accompanied by a remittance. The rates for Displayed Advertisements will be forwarded on application. Classified Advertisements cannot be inserted unless delivered before TWO o'clock on Thursday afternoon (the day before publication).

Letters relating to the Advertisement and the Publishing Department of the Paper are to be addressed to the Publisher, all other letters are to be addressed to the Editor of THE ENGINEER.

THE ENGINEER DIRECTORY.

This Directory, which is published annually in the interests of advertisers in THE ENGINEER, may be obtained free of charge on application to the Publisher.

Postal Address, 28, Essex Street, Strand, London, W.C. 2.
Teleg. Address, "Engineer Newspaper, Estrand, London."
Tel. : Central 6565 (8 Lines).

By arrangement with Reuter's Engineering Service, THE ENGINEER *contains the latest news from all parts of the world which is likely to be of interest to engineers.*

Contents.

THE ENGINEER, July 10th, 1931. PAGE

A SEVEN-DAY JOURNAL .. 27
THE YALLOURN LIGNITE-OPERATED ELECTRIC GENERATING STATION. (Illus.) .. 28
INSTITUTION OF NAVAL ARCHITECTS. No. II. .. 29
THE ROYAL AGRICULTURAL SHOW AT WARWICK. No. II. (Illus.) 31
TRADE AND FOREIGN COLONIES. No. II. .. 35
A VISIT TO THE B.T.H. RUGBY WORKS. (Illus.) .. 36
IRRIGATION RESEARCH WORK IN THE PUNJAB .. 37
LETTERS TO THE EDITOR—Lewin Locomotives .. 38
THE LEIGHTON BUZZARD FATAL DERAILMENT. (Illus.) .. 38
RAILWAY AND ROAD MATTERS .. 39
NOTES AND MEMORANDA .. 39
MISCELLANEA .. 39
LEADING ARTICLES—
History .. 41
Depletion of London's Underground Reservoir .. 41
THE VALUE OF SCIENTIFIC AND TECHNOLOGICAL HISTORY. No. II. 42
LITERATURE .. 43
A NEW STOKER. (Illus.) .. 44
A NEW FORM OF GRIT CATCHER. (Illus.) .. 45
THE FRENCH SUMMER RAILWAY TRAIN SERVICES .. 45
MODERN MACHINERY AND THE DESIGN OF LARGE SHIPS. (Illus.) 46
THE MOTOR CAR INDUSTRY .. 47
SIXTY YEARS AGO .. 47
A WAGON FOR LOCOMOTIVES. (Illus.) .. 47
THE BURKE-SCOTT ELECTRIC WELDER. (Illus.) .. 48
A NEW TYPE OF PIVOTED SIDELIGHT. (Illus.) .. 48
SOUTH AFRICAN ENGINEERING NOTES .. 48
PROVINCIAL LETTERS—
The Midlands and Staffordshire—Lancashire .. 49
Sheffield—North of England .. 50
Scotland—Wales and Adjoining Counties .. 51
CATALOGUES .. 51
CURRENT PRICES FOR METALS AND FUELS .. 52
FRENCH ENGINEERING NOTES .. 53
BRITISH PATENT SPECIFICATIONS. (Illus.) .. 53
FORTHCOMING ENGAGEMENTS .. 54
PERSONAL AND BUSINESS ANNOUNCEMENTS .. 54
CONTRACTS .. 54

NOTICES TO READERS.

*** *If any Subscriber abroad should receive* THE ENGINEER *in an imperfect or mutilated condition, he will oblige by giving prompt information of the fact to the Publisher, with the name of the Agent through whom the paper is obtained. Such inconvenience, if suffered, can be remedied by obtaining the paper direct from this office.*

*** *All letters intended for insertion in* THE ENGINEER *or containing questions should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

*** *No undertaking can be given to return drawings or manuscripts; correspondents are therefore requested to keep copies.*

THE ENGINEER.

VOL. CLII. No. 3939

JULY 10, 1931.

History.

THERE are a great many engineers, old and young, who look upon the study of the history of science and technology as rank waste of time. They pride themselves upon their modernity and would tell you that since Providence has deprived man of the eye at the back of his head, of which the pineal gland is the vestige, it is evident that he is meant to look forward and not backward. The International Congress on the History of Science and Technology, which was held in London last week, must have shaken the faith of such people. It could not be for nothing that eminent scientists of many nations gave their time to the discussion of the value of the study of technical and scientific history, nor can the views they expressed be lightly dismissed. Whatever the utilitarians may say, there can be no question that in the opinion of men of science and technology the history of the ideas and actions which have produced the material basis of civilisation is of at least equal, and possibly of greater, importance than political and military history. The fact that many nations were represented at the Congress is evidence of the world-wide expansion of a belief that there is not only cultural, but actual, material, value in a branch of study which has hitherto been neglected by all save a select few.

There are two aspects from which the history of science and technology may be examined. They may be described as the cultural and the utilitarian. As far as the former is concerned, the history of science and technology stands in the same position as the familar history of our schools and universities. The same arguments which may be employed to show that boys and girls should have some acquaintance with the great political events which have moulded the nations to which they belong, may be used with no less certainty in connection with the progress of science and technology. Indeed, if we do not go so far as to say that the latter kind of history is of greater importance to the understanding of national development, we may at any rate assert that unless something is known of the history of the science, and particularly of the technology, of each country, no complete understanding of its progress is possible. Richard Green perceived this fact, and in his famous work introduced some references to the outstanding events in the fields of science and manufactures in successive periods. But, generally speaking, not only the lesser historians who write for schools, but the greater who write for students and politicians, neglect both science and technology, and even the sociological effects which have resulted from them. It is only necessary to reflect for a single instant on the consequences of the invention of the rotatory steam engine, the construction of railways, the coming of steam navigation, the cutting of canals and the making of good roads to perceive at once that the politicians of the whole world are really the subjects of technological progress and not its masters, as the familiar histories might lead one to believe. Hence, if the object of the teaching of any kind of history be, in essence, cultural, then surely the neglect of those branches which deal with the ideas and facts which come nearest to man in his everyday life, which have had most effect upon his business, and have weighed greatly in all his dealings with the peoples of other nations, is difficult to understand. It is in this cultural argument that the best case for the general teaching of the history of science and technology resides, yet the utilitarian argument is not without weight. Consider any complicated machine of the day. It has sprung up from simpler beginnings and has passed through a succession of changes and modifications to fit it better for the duty for which it was originally designed, or for more onerous duties subsequently imposed upon it. To understand the machine thoroughly, one should know the reasons which have led to the adoption of the form of its parts. For example, imagine the case of a student who was told that turbine cylinders were so designed in order that they might meet temperature stresses, but was shown none of the forms through which they had passed. Is it not obvious, on the one hand, that he would miss a valuable lesson from experience, and, on the other, that, not knowing of the failures, he would, if of an inquiring mind, be continually asking himself why some other configuration was not adopted, and, perchance, introducing into design, forms which engineers in the past had found to be defective ? But the strongest, most general, argument is that a thorough understanding of anything is best acquired—perhaps can only be acquired—by knowing its history from the beginning. That is especially true of science and technology. The elements of chemistry, physics, or mechanics are far more completely grasped by going back to the work of the great pioneers in those subjects than by studying only the work of later experimentalists with more complicated apparatus, and can never be fully understood, as some text-books would seem to imply, from mathematical expressions alone.

The great philosophers and teachers of the past insisted that the object of education was the encouragement and development of "virtue," by which was meant all manly characteristics. That view of education has given way before the pressure of business, so that vocational education intrudes, even into the elementary school. The old tenet was responsible for Pope's trite adage and led, no doubt, to the form that the teaching of history has taken. If the proper study for mankind is man, then the familiar histories follow a right, if limited, course. But the lives of the great scientists and great technicians are just as rich in educative materials as those of kings, soldiers, prelates and statesmen. They also had their difficulties to overcome, they also showed courage, and perseverance, they also exhibited human weaknesses. Their "lives" are, then, fully worthy to be set down in the pages of history, and since their works have had more effect upon the world than that of all the politicians combined—for the politics of the world are ruled by its industries—it is fit that the story of them should be taught in every school, even if such teaching necessitates the displacement of some of the present subjects. The International Congress has met only twice ; it will not be called again for three years. But it already sees opinion changing and in all parts of the world more attention being given to the matter for which it stands. It may be many years before the history of science and technology takes its proper place in the curricula of schools and colleges, but a good start has been made and the influence of the Congress will increase from year to year.

Depletion of London's Underground Reservoir.

IN its issue for July, our contemporary, *The Chamber of Commerce Journal*, printed an article entitled "London's Water Supply—Menace to Natural Underground Reservoir." The article

was written by Mr. James Romanes, F.G.S., who begins by remarking that, at the present time, two major problems confront London and the Thames Valley. They are: (*a*) Periodical flooding, and (*b*) the only too well-recognised fact that the level of the water table in the chalk of the London basin is rapidly falling. The one problem, he asserts, is the complement of the other. While we are using all the most modern methods to abstract the maximum yield of water from the London basin, modern land drainage is, by ensuring a quick run-off, preventing the adequate replenishment of that underground source of supply.

London, Mr. Romanes points out, has under it a wonderful natural reservoir, which is immensely greater than any artificial storage that could come within practical construction, and which we are rapidly ruining with no thought for the morrow. Of late years, mainly with the object of evading the payment of heavy water rates, many large users of water, and occupants of highly-rated business houses in London and the lower Thames Valley, have had bore-holes sunk through the clay into the chalk. The result of abstracting large volumes of water by means of those bore-holes has been that the hydrostatic pressure, which originally existed under the impervious clay strata and caused the water to flow freely to above the ground surface, has been gradually but steadily reduced for many years, until now the water table under London has fallen "far below the base of the Tertiaries and the upper part of the Chalk is dry." In fact, the water table is falling at the rate of 4ft. per annum. That fall, contends Mr. Romanes, is serious from two points of view: (1) It necessitates the putting down of new wells to a lower level than was necessary for the wells sunk in former years, with, consequently, greater expense, both for sinking and pumping; and (2), owing to the fall of water level, pollution of the chalk water is taking place—probably from two sources. The pollution may either be occasioned by the brackish water from some of the Lower Tertiary sands, which is pouring down through many of the old wells, in which the lining tubes have eroded away; and "there is almost certainly direct pollution by the entry of the salt water of the Thames Estuary into the chalk." That salt water pollution is, Mr. Romanes maintains, steadily and rapidly encroaching on the London basin. To counteract the menace, there is, he says, one possible remedy, and only one. By modern methods we have upset the natural circulation of the water, and it is by modern methods that we must restore the balance. He admits that the problem is complex geologically, mechanically and financially, but his suggestion is that we should begin the replenishment of the chalk "by diverting some of the flood waters of the Thames and its tributaries through filter beds to shafts or bore-holes carried down to porous zones of the chalk." It is an obvious fact, he urges, that any well that will give water will take water. If one considers a well sunk into the chalk, striking water at, say, 250ft., and capable of pumping 1,000,000 gallons per day with a depressed head of, say, 30ft., one can realise the amount of water that the same well would take, instead of give, with a head of 250ft. instead of a depressed head of only 30ft. Further, granted that the water was sufficiently filtered to prevent silting, the tendency would be to develop solution channels in the chalk, which would steadily increase the intake of the well. "Geologically," he adds, "the feasibility of the scheme depends (*a*) on whether the lowering of the water level is sufficiently widespread to admit of recharging, or whether it is purely an increase of the 'cone of depression' which is due to the ever-increasing rate of pumping, and (*b*) on the rate of migration of water through the porous zones of the chalk and how continuous the latter are." Mechanically, he continues, there are no real difficulties in filtering the flood waters and admitting them to strategically placed wells or shafts, but the "financial side of the question is certainly the greatest difficulty, for the scheme proposed is large and costly." Yet, though it would chiefly benefit the private owners of wells in the London area, it would at the same time increase the value of land. It would not, he asserts, take any very great outlay to have the problem thoroughly investigated, and, if the scheme be found feasible, it is surely worth carrying out.

Mr. Romanes' suggestion is full of points which call for comment, but in discussing it we propose, at the present moment, to confine ourselves only to a few of them. The waters of the Thames and its tributaries, when those rivers are in flood, are turbid and much polluted. The surplus discharge from sewage works, over and above a certain volume—generally three times the dry weather flow—is passed direct into them without treatment. Hence the waters at such times—which would, nearly certainly, coincide with floods—are distinctly impure. To remove their suspended solids so as to prevent silting is not sufficient to purify them. Hence, if this impure water were admitted by shafts in a merely screened condition to porous chalk in which there may be "solution channels," there is evidently risk of contaminating the water of the underground reservoir. To purify and sterilise the water thoroughly before it is admitted to the shafts would be an immensely expensive business, not only in first cost, but in the working and maintenance of the necessary equipment. Besides, having thus rendered the impure water fit for human consumption, what would be the object of letting it sink some hundreds of feet into the ground in order to pump it up again? The cost of installing and operating roughing filters to remove silt—especially the cleaning of them when clogged—might alone prove to be prohibitive. But, apart from that question altogether, there are other points which arise for consideration. The rivers in the Thames Valley are not always in flood; indeed, they are comparatively rarely in that condition. Does Mr. Romanes contend that during the few times they are so, a sufficiency of water would flow down the shafts to make good the drain made upon the reservoir by pumping which is carried on continuously? Then, again, it is clear that the shafts could only be sunk effectively in the areas where flooding occurs. That would settle their positions, but could Mr. Romanes be sure that they would not come near wells in operation? If river water only roughly screened and not sterilised were delivered into the chalk near a well that was in use, it is more than likely that that well would yield impure water, especially if it happened to draw from a "solution channel." These points alone would appear to militate against the proposal, which, in any case, does not abolish the acknowledged contamination that is taking place through worn away well linings. While everyone deplores the lowering of the level of the water table in London's underground reservoir, we are afraid that the present proposal would not satisfactorily redress the evil.

The Value of Scientific and Technological History.

No. II.*

LAST week we referred to the early part of the proceedings of the Second International Congress of the History of Science and Technology. We give below a *résumé* of the discussions and the activities of the delegates during the latter part of the week.

THE PHYSICAL AND BIOLOGICAL SCIENCES.

On Thursday, July 2nd, the whole of the morning session, held at the Science Museum, South Kensington, was devoted to a discussion of the historical and contemporary inter-relationship of the physical and biological sciences, under the chairmanship of Professor William Ritter, of the University of California.

This discussion indicated two schools of thought. The one—to which Dr. Joseph Needham, of Cambridge, adheres—is that biology is dependent on modern physics, and he says that what might be called the style of the physical sciences has played a steadily increasing part in biological investigation during the last century, and he wishes to see this influence extended further. The other—which was championed by Dr. J. S. Haldane, F.R.S., of Oxford—is that biology is an independent science. A point made by Dr. E. S. Russell, O.B.E., Director of Scientific Fishery Investigations, Board of Agriculture and Fisheries, is that the influence of the physical sciences on biology has been on the whole unsatisfactory, and he expressed the belief that it has tended to inhibit the development of biology as an independent science.

Late on the afternoon of July 2nd, there was a reception of delegates at the University of London Institute of Historical Research, which owes its inception to its present Director, Professor A. F. Pollard, and is primarily a laboratory for post-graduate historical work. Its temporary building contains a series of systematically planned seminar rooms, each appropriated to one or more of the groups working at the Institute, and housing, in addition to a library of nearly 40,000 volumes of printed historical materials, the indexes and other apparatus used by the seminars. The Institute is also a national office for historical research.

In the evening the delegates were received by the Right Hon. Lord Dawson of Penn, P.C., and Lady Dawson of Penn at the Royal College of Physicians—the oldest scientific society in England, holding its charter from King Henry VIII.

* No. I. appeared July 3rd.

PURE AND APPLIED SCIENCE.

The subject for discussion on Friday was that of the Inter-dependence of Pure and Applied Science. Sir Henry Lyons, F.R.S., Director of the Science Museum, presided. Among the many eminent speakers in this discussion was Sir W. Napier Shaw, F.R.S., who said that the history of civilisation was emphatic as to the importance of science in common life and of the reflex action of that importance upon the sciences themselves. Some sciences had to live on their services to the public—that certainly was a part of the interdependence of pure and applied science. The facilities required by every branch of science, he said, were an observatory for the acquisition of experience, a laboratory for the formation and trying out of ideals, a library for the development of co-operation, and an arena for exposition and discussion. He placed upon these facilities the responsibility for the analysis which led to the inductive representation of nature and the synthesis which enlarged our vision of the structure. Speaking generally, the analysis belonged to the observatory and laboratory, the synthesis to the library and arena. Anticipation of events in given conditions was a commonplace of applied science. Speaking generally, every experiment in the laboratory was a test of a forecast; the laboratory was also an observatory, because the apparatus might disclose something which was not anticipated.

Another speaker in this discussion was Professor C. H. Desch, F.R.S., who is at present Head of the Department of Metallurgy at Sheffield University, and is the newly appointed Director of Metallurgy at the National Physical Laboratory. He urged the need for greater efforts to make the influence of science felt in the world of citizenship and to bring home to the public the value of the services that science, rightly interpreted, can render to the community. The task, he said, might appear to many to be superfluous. In spite of the general opinion, however, that science dominated the present age, it must be admitted that it was not rendering to society more than a small fraction of the services of which it was capable, whilst the habit of scientific thought remained foreign to all but a tiny minority, even among the most advanced peoples. The great field of citizenship, private and international, remained almost untouched by it. The most obvious social result of the advance of scientific knowledge in the nineteenth and twentieth centuries had been the mechanical transformation of industry—the development of means of transport and of communication, and the introduction of new luxuries. Yet, although science had made these things possible, it was easy to live amongst them and to make daily use of them, and to remain untouched by scientific thought and ignorant of the rudiments of science. These inventions which loomed so large in the life of to-day were the products, often the more or less accidental by-products, of scientific investigation, and their possession did not necessarily imply any understanding or appreciation of what science meant.

In making the point that excessive specialisation was an evil, he said that as specialisation had gone on we had not had the necessary corrective of general instruction in the rudimentary principles of the other sciences as part of general education. It was often excused on the ground that it was impossible for anyone to be a master of more than a tiny corner of some science. It was said to be a consolation that that tiny corner might be known thoroughly, but it seemed that even that consolation was illusory if one were unaware of the relation of that corner to the rest of that science, and of the relation of that science to the rest of the sciences. That was where the study of the history of science came in, as a corrective. In the past natural resources had been used without the slightest reference to the future, but, with a realisation of what science could do for humanity, a new conception had grown up, in which the conservation of natural resources became important, and in which the amenities of the country were no longer neglected. There was a transition, made possible by the advance of science, and possibly by that means only. It was little realised how incomparably greater were the resources available to mankind at present than 100 years ago. It was possible that scientific knowledge could transform the world in a manner exceeding the expectation of even the most Utopian theorists.

Lastly, he urged that the scientific habit of mind in the public could only be brought about by a great improvement in scientific education, by a recognition of sociology as one of the sciences from which there would grow up a body of applied science bearing the same sort of relation to politics and finance that the sciences of biology and applied biology bear to agriculture and to medicine.

A plea was made by Professor Donnan, F.R.S., of University College, London, for the employment of theoretical physicists in the large industrial undertakings; it seemed to him fundamental to maintain in every works laboratory or department an atmosphere of intellectual ideas.

Another of the speakers in this discussion was Dr. G. Windred, who pointed to many examples,

in the history of electrical theory, of the manner in which pure science had produced discoveries of great practical importance. He instanced Oersted's discovery, made in 1820, of the magnetic effect of an electric current, and Faraday's discovery of the phenomenon of electro-magnetic induction, and the manner in which the work of these two men was advanced by the mathematicians. Another outstanding example of the relationship between pure and applied electrical theory was afforded by the modern theory of electrons, founded by Sir. J. J. Thomson, at Cambridge. That highly abstract theory was one of the last from which we would anticipate the emergence of practical utility; yet the electron had made possible the conveyance of wireless messages and the use of X-rays.

A study of scientific history made it evident that there could be no independence between pure research and experiment on the one hand, and the practical application of scientific principles on the other hand. Each branch depended for its development upon the other. Neither could we regard pure mathematics as distinct and apart from scientific developments; it had given us some of the most valuable theories we possessed. The present tendency of intense specialisation made the progress of science more than ever dependent upon the co-ordination of pure and applied theory, which could be achieved only through close collaboration between the pure theorist and the practitioner.

A Convention in Berlin.

An invitation was extended to the Congress on Friday morning, on behalf of the German Government, to hold the third International Congress in Berlin in 1934. This invitation was gratefully accepted.

The Chicago Centennial Exhibition, 1933.

Some particulars were given concerning the international exhibition to be held in Chicago, in 1933, in connection with the celebration of the centenary of the incorporation of Chicago as a municipality. The principal theme of this exhibition is to be the dependence of industry upon the pure sciences, and to achieve this object it is proposed to exhibit outstanding discoveries which have been made in the pure sciences. The main theme of the exhibition will be divided into two parts—basic science in its historical sense, and science in its application to industry. The President of the United States has issued an invitation to the Governments of the world to participate in this exhibition by demonstrating the part their nationals have taken in benefiting mankind, and the results of this invitation are already very gratifying. It is not proposed to create a complete scientific museum, either historical or otherwise, because that would defeat the object in view. The appeal is, primarily, not to scientists or to laymen interested in science, but to the public at large, who have no scientific knowledge whatever and only a vague interest in it. It is the intention to give a general bird's-eye view of discoveries in all branches of science and of their significance in the daily lives of the people.

On Friday evening the official banquet of the Congress was held at the May Fair Hotel, London.

As has been indicated, the conference programme was arranged so that each session was devoted to the discussion of a particular theme. On Saturday, however, the last day of the Congress, there was a further session, at which delegates from Russia presented a number of papers which they had prepared on various subjects. Printed copies of these papers, numbering about a dozen, were prepared, and their authors briefly introduced them. They dealt with various scientific and technological subjects, but were written from the point of view of the Soviet Union as opposed to capitalism, and it is not unfair to say that to some extent they were vehicles of propaganda. One of them, dealing with electrification as the basis of technical reconstruction in the Soviet Union, was ruled out of order on the ground that it constituted prophecy rather than history.

Physics and Technology.

One of the papers, however, by Professor A. Joffé, a member of the Academy of Sciences, Leningrad, was entitled "Physics and Technology," and contained a plea to physicists not to neglect certain physical problems, which, he maintained, are being forgotten by them, but which are of importance to technique. For instance, he pointed out that a reversible oxidation of coal could increase three or four times the energy available for technical purposes; that we exploited the sun to only a ridiculous extent as a source of energy; that we should develop photochemistry and photoelectricity much more than we do; that as a direct method of deriving electrical energy from thermal sources the thermo-electrical phenomena have to be studied far more closely; that powerful beams of high-speed electrons or protons and concentrated electro-magnetic waves could find considerable application within the chemical and electrical industries, and so on. He pointed out that the limiting stresses which a physical body could stand were found to be much in excess of the limits actually reached. For instance, we were able to state that an electrical breakdown could be prevented up to a field of over one hundred million volts per centimetre, while we still used a field of only forty thousand volts. We had also increased the mechanical strength of crystals many hundreds of times. We had discovered substances with an electric constant of over 20,000, while no more than ten were used. An extensive field of investigations was awaiting exploration in order to make the results available to technique.

Again, the sensitiveness of the methods developed by physics and chemistry was very striking. We could detect a single electron and proton, and less than one hundred protons of ultra-violet and even visible light. X-rays and electron rays analysis revealed the finest details of structure. Wireless waves could be detected after they had travelled a hundred thousand miles. Why, he asked, had we not adapted these methods to use in everyday life?

There were innumerable other such problems, he concluded, and he was convinced that physicists were wrong in neglecting them. Not only would their investigations be of practical use, but they would lead to the development of new problems, would lay bare new features of phenomena known to us only under one aspect.

It was stated by Mrs. Singer, the wife of the President of the Congress, that the International Committee of the History of Science had anticipated Professor Joffé; it had appointed a commission to formulate a list of problems in the history of science which needed elucidation, and the list would be published in the international journal *Archeion*.

The delegates were entertained to luncheon on Saturday, at the University College, Gower-street, by the Provost of the College, Dr. Allan Mawer. That was American Independence Day, and General Dawes, the American Ambassador, had intended to be present, but was unable to attend. He was represented, however, by the Chargé d'Affaires.

A number of the delegates visited Oxford during the day.

Literature.

Electrical Insulating Materials. By B. H. Warren. London: Ernest Benn. Price 42s.

To insulation specialists and electrical designers alike this volume can scarcely fail to appeal. Designers of electrical machines and general users of insulation can only make the best use of the products available by acquiring and keeping up to date a knowledge of the advantages, limitations, and peculiarities of the different materials. The author of this volume has therefore made an attempt to present to designers a concise account of the matters concerning insulation with which they should be acquainted, and he also deals with the subject from the point of view of general users. Mainly the book considers materials and processes and not design. The materials are grouped together according to whether they are natural materials, vitrified products, moulded compounds, sheets, rods and tubes, liquid insulations, treated sheet materials, or wire coverings. The result is that materials have been brought together which are worked by more or less common processes that involve similar chemical and engineering problems, and that are applied to associated uses.

Of the natural mineral insulations, mica is, of course, the most important. Its high electrical properties, mechanical strength, ease of cleavage into continuous laminæ, purity, chemical inertness, and resistance to high temperatures, place it in a class by itself, and it is not surprising that Mr. Warren has found it necessary to give much attention to this material and its products. Next to mica, asbestos is probably the most used natural insulation, and here, again, suitable attention is paid to asbestos and its products. Slate, marble, and basalt are also dealt with in the section of the volume devoted to natural mineral insulations.

Coming to vitrified insulations, &c., the author considers porcelain, stoneware, steatite—the youngest member of the electrical ceramic family—quartz, glass, and vitreous enamels. Steatite is shown to be the strongest of the ceramic insulations. Its average tensile strength is 9200 lb. per square inch, its compression strength 90,000 lb. per square inch, and its impact strength 1·6 foot-pounds per square inch. The material is hard and tough, and is particularly well suited for use where mechanical stresses are severe. An important composition of steatite and porcelain is known as "Melalith," and one of the most interesting illustrations in the book is that of a single piece 220-kV Melalith insulator which is nearly 11ft. high.

Although the use of quartz in the insulation field is limited by the difficulties and cost of manufacture, this material is, as we have said, duly considered. Quartz is a good and durable insulator, but until its production has been greatly cheapened, which does not at present appear to be at all likely, it will only be used for special purposes. The various applications of glass to insulation problems are touched upon by the author whilst considering the composition, manufacture, and characteristics of the material. Although vitreous enamels are used far more as protective and ornamental coatings than as electrical insulating media, their composition properties, &c., are discussed, for there are definite, though isolated, cases when the vitreous enamelling process is applied primarily as electrical insulation. The enamels or glazes on porcelain and steatitite perform an important electrical function in that they ensure a smooth and impervious surface, and these special enamels for ceramic bodies are referred to in appropriate sections of the book.

The third part of the volume is devoted to moulded composite insulations. The ceramic and vitreous materials discussed in the previous chapters are, of course, moulded compounds, but the compounds discussed in this third portion of the volume are compositions that can be moulded and cured at moderate temperatures, *i.e.*, below 250 deg. Cent. Two chapters are devoted to natural and artificial organic binders used in these moulded insulations; whilst others deal with fillers, pigments, &c., moulded compounds with natural binders, with rubber binders, hydraulic cement binders, and with synthetic resin binders. Other chapters on the design of moulded parts and on moulding equipment bring Section III. of the book to a close. In view of the important part these moulded insulations now play in the electrical industry, this section of the volume should be widely appreciated.

Sheet, rod and tube insulations are considered in Section IV., which, like the previous section, is well illustrated. Here the author has much to say about materials such as wood, paper, pressboard, fibre, &c., and the manufacture of laminated paper, fabric, &c., boards, tubes, cylinders, and mouldings is discussed.

The three last portions of the book deal with varnishes, &c., treated sheet insulation and sleeving, and cotton, silk, and asbestos and other wire insulation. It is shown that the art of making varnish for impregnating coils, wrappings, &c., is by no means devoid of difficulties. It demands great care and experience in the selection and handling of materials and skill in the carrying out of the different essential processes, so that uniformity of the product is achieved. Most of the electrical firms in this country adopt the sound policy of purchasing their varnish from a varnish maker of experience and repute, but the author, nevertheless, indicates the general lines on which insulating varnishes are compounded, without endeavouring to detail the composition of any particular varnish on the market. The section on varnishes also covers protective enamels and paints, bonding varnishes and lacquers, cementing, sealing, impregnating and filling compounds, and mineral oils.

It is believed that the book covers the engineering aspect of all the important insulations used in the construction of electrical apparatus, but cable insulation has been omitted or only mentioned incidentally, because this is a specialised matter which has been dealt with in many other books particularly devoted to the subject. No other volume, so far as we are aware, covers the same ground as Mr. Warren's book, which, in view of the important part insulation plays in electrical engineering, ought to meet with a very good reception.

BOOKS RECEIVED.

Journal of the Institute of Metals, Vol. XLV., No. 1, 1931. Edited by G. Shaw Scott. London: The Institute of Metals, 36, Victoria-street, S.W. I. Price 31s. 6d. net.

Workshop Notes on the Condor Engines. Series 111A, 111B, and 111BHS. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 3s. net.

Selected Papers from the Journal of the Institution of Engineers, Australia. Vol. I. 1929. Sydney: The Institution of Engineers, Australia, 16, College-street, Australia.

Report of the United Kingdom Trade Mission to Egypt, February–March, 1931. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 1s. 6d. net.

Examples in Power Distribution and Electric Traction. By A. T. Dover, M.I.E.E. London: Sir Isaac Pitman and Son, Ltd., Parker-street, Kingsway, W.C. 2. Price 3s. 6d. net.

Tables and Memoranda. Seventh edition. By J. Wright Clarke, revised by W. Scott. London: B. T. Batsford, Ltd., 15, North Audley-street, W. 1. Price 2s. 6d. net.

Naval Operations. Vol. V.: 1917 to the Armistice—two parts. By Sir Henry Newbolt. London: Longmans, Green and Co., Ltd., 39, Paternoster-row, E.C. 4. Price 31s. 6d. net.

A Routine Test of the Inflammability of Mine Dusts. Paper No. 68. By A. L. Godbert. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 6d. net.

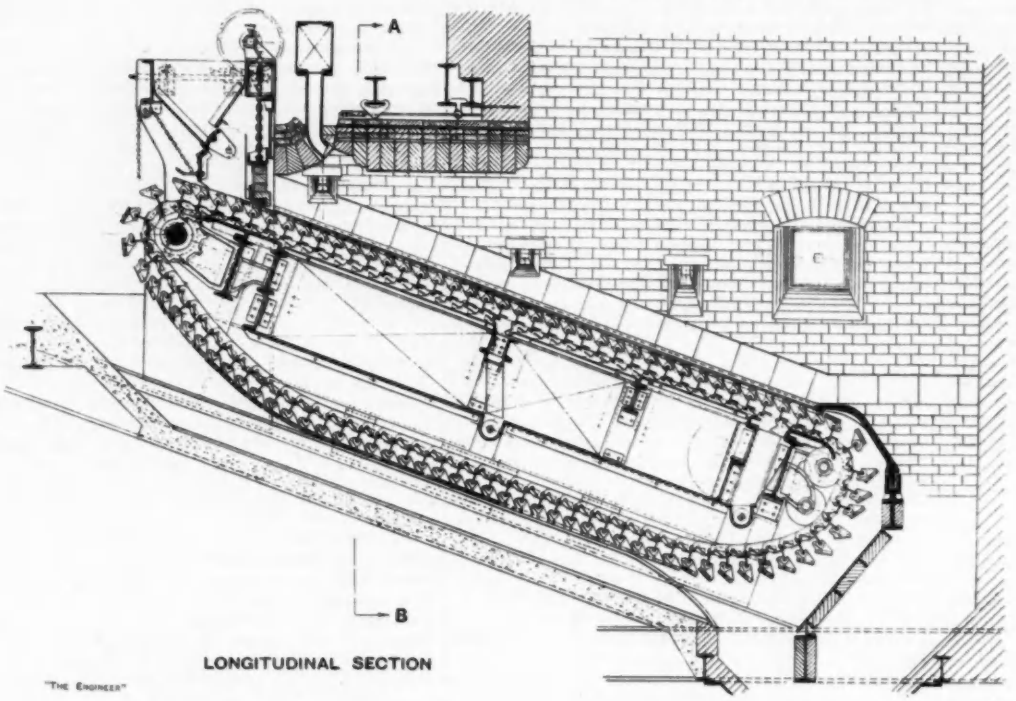
The Sulphur Compounds in Water-gas and their Removal. Fuel Research Technical Paper No. 31. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 9d. net.

Economic Conditions in the United States of America, March, 1931. Report by Sir J. Joyce Broderick, K.B.E., C.M.G., and A. J. Pack. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 3s. net.

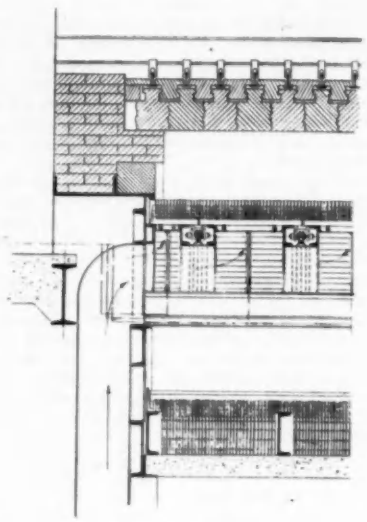
A History of the British Chemical Industry. Written for the Society of Chemical Industry on the occasion of the Fiftieth Anniversary of its Foundation. By Stephen Miall. London: Ernest Benn, Ltd., Bouverie House, Fleet-street, E.C. 4. Price 10s. 6d. net.

CHAIN GRATE STOKER ON A YARROW BOILER

ED. BENNIS AND CO., LTD., BOLTON, ENGINEERS



LONGITUDINAL SECTION



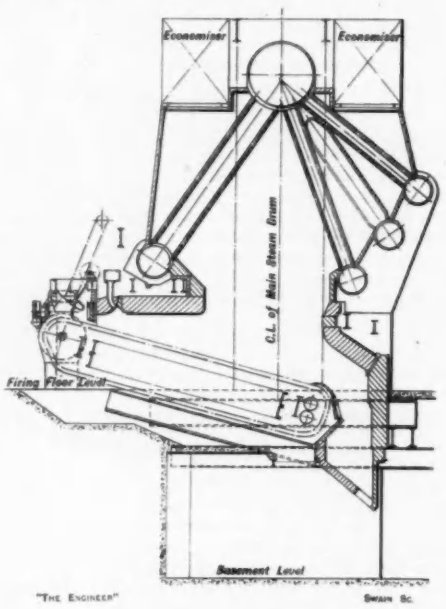
PART CROSS SECTION "A. B."

SWAIN SC.

A New Stoker.

WE recently examined at the Bankside station of the London Electric Company a comparatively new form of chain grate stoker, which has been installed under a Yarrow boiler by Ed. Bennis and Co., of Little Hulton, Bolton, and is illustrated herewith.

The chain grate stoker is, of course, familiar to power-house engineers, but there are some distinct peculiarities about this example, and it is "flexible" in the extreme. Thus, when we arrived in the boiler-house, this individual boiler showed an evaporation of over 70,000 lb. per hour. Within 10 minutes the load had gone off the plant and the demand for steam dropped to some 20,000 lb. We noted that the attendant—they can hardly be called stokers, or firemen, nowadays—made some adjustments in the feeding gear of the stoker, and we hastened to the yard to observe the top of the chimney. There was no appreciable difference in the appearance of the fumes coming from the top of the stack devoted to this boiler. The seriousness of



BOILER AND STOKER

this matter in the eyes of the authorities may be gauged from the fact that a man is permanently stationed on the roof of the power-house to signal to the boiler-house, by means of coloured lights, if any one of the stacks is smoking. The portion of a steam meter chart reproduced herewith shows the abruptness with which these fluctuations in load may occur.

In order to obtain the high rates of evaporation now demanded of large boilers and yet retain the flexibility we have just mentioned, it has generally been thought that recourse must be made to powdered coal or oil fuel, or, if it is necessary to burn lump coal, to use very high forced draught pressures, with a consequently large expenditure of power in the fans. The only other alternative would be to have widely spaced fire-bars, to pass the large volume of air necessary, and that would involve the loss of a considerable amount of unburned fuel in the ashpit. The new Bennis stoker, however, meets these difficulties, apparently, with complete success.

The construction of the stoker can best be followed with the aid of the line drawing, while the photograph of the installation at Bankside reproduced below shows its general appearance. This stoker, by the way, is 16ft. wide by 15ft. long, and is, we believe, the widest single stoker in this country. Across the front of the boiler there is a massive shaft with bearings at the ends and one in the middle, so arranged that they are well away from the hot part of the grate and can be properly lubricated. On this shaft there are keyed a number of sprockets for the chains, which run over idler pulleys at the rear. The idlers are mounted on short shafts, and as they have no driving effect are readily kept in line. Bolted to the links of the chain there are a number of transverse bulb angle bars, with the bulbs standing upwards. On to the bulbs there are threaded the fire-bars themselves. These bars have a "half-hole" in the web of the base, which is plainly shown in the drawing, so that they are free to swing on the bulb when passing over the front sprocket and the idlers at the back. In the event of one of the bars becoming damaged and requiring replacement, it is deliberately broken up, so that it may be taken off the bulb. Its neighbours are moved up and a new bar can then be inserted at the end. The general contour of the fire-bars can be followed in the illustrations. They are about 5in. long by ⅝in. wide, and have lugs cast on the sides, so that they are separated by an air space of about $\frac{1}{16}$ in. when assembled. Grooves are cast in their sides for passage of air to the fire. The result is a very finely divided grate surface, through which there is ample passage for air, while it is self-cleaning of clinker on account of the relative movement of the bars as they pass over the idler pulleys at the back. This action is plainly shown in the drawing.

Beneath the bulb angles and depending from pivots on the chains there is a series of V-shaped troughs, which run from side to side of the stoker under the gaps between the angle bars. These troughs ride on longitudinal skid bars, and serve a dual purpose. They are intended to catch any coal, or ash, which may work its way through the air spaces of the grate, and also to regulate the passage of air through the grate at the various parts of its length and width.

The width of the grate is divided transversely into a series of strips, each of which has its own chains, skid bars and troughs, and each of these strips is, again, subdivided longitudinally from the point of view of air supply, so that the whole grate is sectionalised, and if any uneven burning is manifest the local conditions can be adjusted while the boiler is at work.

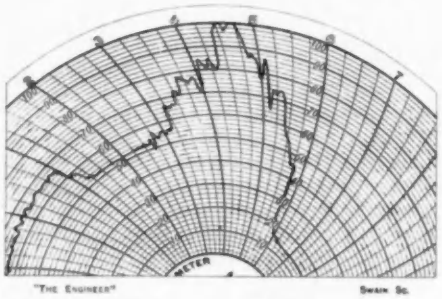
In the stoker inspected, there are five sets of skid bars for the troughs, and of these, two, at the front and back of the grate, are fixed at such a level that the troughs are closed up, on their pivots, tight against the bottom of the bulb angles, and, consequently, prevent the passage of air from the wind boxes below the fire. The other sets of skid bars are carried on bell-cranks and each crank is controlled by a hand wheel at the front of the boiler. The connections of the troughs are made reasonably flexible, and, as a consequence, the skid bars can be so adjusted by means of the bell-cranks that the opening for the passage of air between the lips of the troughs and the undersides of the bulb angles can be varied, both longitudinally and transversely, as required by the immediate state of the fire as regards the supply of air. In other words, should a hole burn through the bed of the fire, that part of the grate can be temporarily shut off from its supply of forced draught air until such time as a further supply of fuel has come forward to close up the hole. The value of this feature in the hands of an industrious attendant, in the

CHAIN GRATE STOKER AT BANKSIDE POWER STATION

way of improving the CO_2 content of the flue gases, needs no emphasis.

At two positions along the length of the grate the skid bars are stopped entirely, so that the trays drop right down and spill their contents into shoots below. The first of these shoots, it will be seen, is at about the end of the travel of the grate, representing preliminary combustion, and into it there are dumped the riddlings that are still combustible. At the bottom of the shoot there is a screw conveyor and the stuff collected is returned to the fuel hopper as occasion requires. The second shoot at the rear collects the ashes coming through the grate and delivers them, by another screw conveyor, to the ashpit. In this way the wind box of the stoker is kept clear of detritus and, incidentally, a certain amount of burnable fuel is saved. It will be noticed that in the front of the stoker there is a light roller, which bears against the top faces of the fire-bars. Its function is to fair up the bars and make sure that none has got stuck up with slag, or ashes, so that they must present an even surface as they enter the furnace again.

The change speed gearing which is used to drive the stoker needs little comment, as it is standard engineering



STEAM METER CHART

practice and combines spur gears for varying the speed, with a heavy worm gear for coming down to the necessarily slow speed of the chain. It is all enclosed in oil baths.

Some idea of the small amount of power required by the stoker and its auxiliaries may be gathered from the following figures. At normal load—that is to say, when the boiler is evaporating 65,000 lb. per hour—the stoker requires 2·2 kW, the induced draught fan 17·6 kW, and the forced draught fan 15·4 kW. The corresponding figures at a load of 85,000 lb. per hour are 2·9 kW, 55 kW and 42 kW respectively, with an air temperature of 310 deg. At an overload of 115,000 lb. per hour, the figures are 3·5 kW, 68 kW and 70 kW, with an air temperature of 315 deg. The average CO_2 reading was between 12½ and 13 per cent.

A New Form of Grit Catcher.

RECENTLY we had an opportunity of studying at work some demonstration examples of apparatus for separating grit and other solid matter from gases, which have been designed by Pneumatic Conveyance and Extraction (1929), Ltd., of Broadway Buildings, Broadway, Westminster. These grit catchers, which have been erected in the old Palace of Engineering at Wembley, are full-sized models, and are intended to demonstrate the effectiveness of the apparatus for such purposes as cleaning boiler-house flue gases. On the occasion of our visit an experiment was

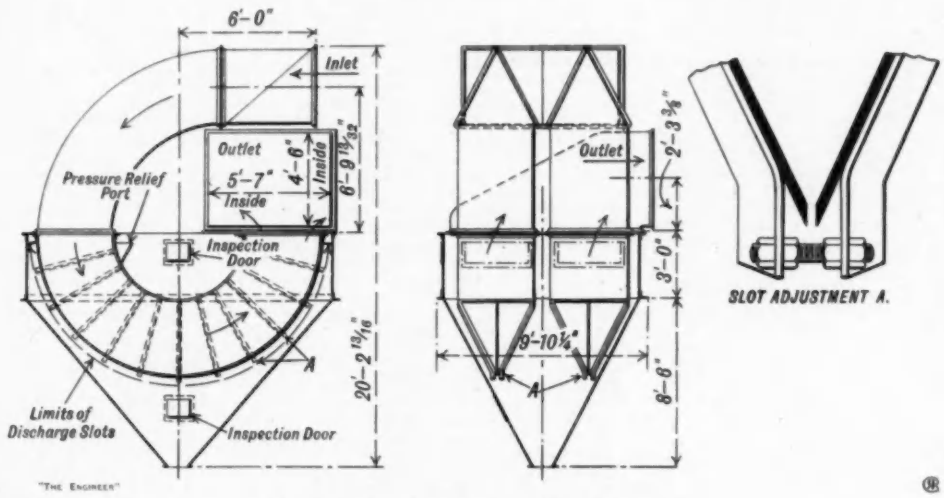


FIG. 1—ARRANGEMENT OF GRIT CATCHER

being carried out to determine the efficiency of the plant in ridding the flue gases of Portland cement works of the almost impalpable powder which they commonly carry away. Such fine dust is naturally much more difficult to extract than the larger particles of boiler-house flue gases, and the effectiveness of the demonstration gives promise that the power-house problem may be effectively tackled. It should be pointed out, however, that no claim is made for the apparatus in the way of the elimination of sulphurous or other gaseous products of combustion. The illustrations which we reproduce do not represent the demonstration plant to which we have just referred, but rather actual examples which have been put into practical service. The principle, however, remains the same.

The essential feature of the apparatus is a scroll-shaped passage of triangular cross section, through which the dirty gases are drawn. In passing round this scroll, which is best illustrated in Fig. 1, the grit, on account of its greater specific gravity, is thrown to the circumference, and escapes through a narrow slot into a hopper, from which it can be withdrawn, either continuously or intermittently. The slot is arranged at the apex of the triangle, as shown in the detailed sketch of Fig. 1, and can be adjusted as to width by means of nuts and bolts. The width of the slot naturally varies with the conditions of working, but may be taken to be from ⅛in. to ¼in. It is, however, generally opened out near the inlet end of the scroll, where the greater part of the heavy grit is separated out, and may be as much as 1in. wide there. It might be thought that this narrow slot would tend to get choked up, but we are assured that this very seldom takes place, and then only

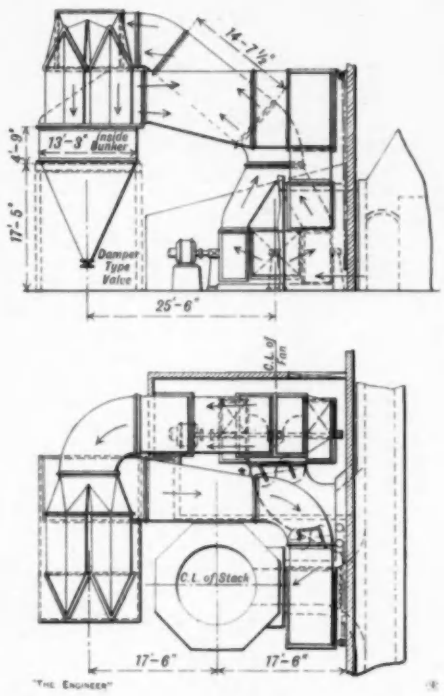


FIG. 2—GRIT CATCHER FOR FOUR BOILERS

after long intervals of continuous work. The plating which is subject to abrasion by the grit is of special steel hardened by extra rolling.

It will be noticed that two scrolls are used alongside one another, instead of one large scroll, and it is for the following reason:—With two scrolls having a total cross section equivalent to one scroll, the total length of slot available for the discharge of grit is increased in the ratio of 1 to 1·4. At the same time the radial depth of the scroll is decreased in the ratio of 1 to 0·7, so that any grit which is near the inner circumferences of the scroll has a correspondingly lesser distance to travel before it can escape.

It is found that there is a tendency for very fine dust to cling to the sides of the scroll and be gradually swept round to the outlet by the gases. As a consequence, some narrow slots are cut near the exit from the scroll, and are covered with louvres, as shown in Fig. 3. These louvres divert a thin layer of gas, containing the very fine dust into the hopper. This air travels across the hopper and finds its way back into the scroll by the opening marked "Pressure relief port," in Fig. 1. The fine dust then mixes with the heavier grit in the incoming gas, which helps to hasten its extraction, presumably on account of gravitational action.

That the extraction of this very fine dust is nearly complete we assured ourselves on the occasion of our visit to Wembley. In the outlet duct of the catcher which was being tested with fine cement dust there was a small door. Through this door there was inserted a glass rod smeared with vaseline. Even when the apparatus had been running for well over half an hour the deposit of dust on this rod was only just perceptible with the naked eye.

In Fig. 2 we give the general arrangement of one of these grit catchers which has been installed in a large oil refinery in South Wales. It is used to clean the flue gases coming from four John Thompson water-tube boilers, three of which are fired by stokers, while the fourth burns oil. In consequence of the plant having to be fitted into an existing confined space, it was necessary to arrange the induced draught fan in advance of the grit catcher, with the result that the fan blades are subject to abrasion by the grit. Wherever circumstances permit, however, the fan is put after the catcher, so that it is protected.

Three of the boilers connected with the plant illustrated evaporate 35,000 lb. of water per hour, while the fourth has a capacity of 45,000 lb. The calorific value of the fuel is 12,000 B.Th.U., and its ash content 30 per cent. The gases

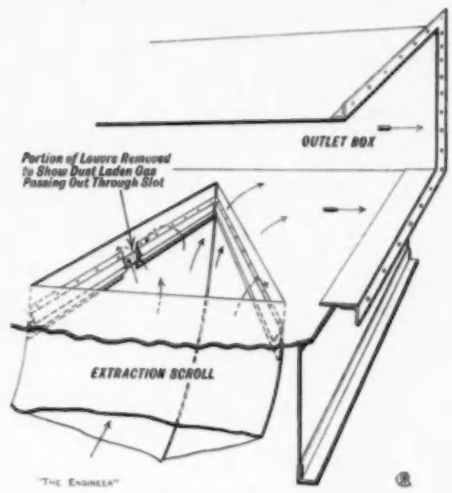


FIG. 3—EXIT END OF SCROLL

contain 12·25 per cent. of CO_2 at the stack, and have a temperature of 500 deg. Fah. The evaporation factor is 7 to 1. During the twelve months that this plant has been in operation the grit catcher has collected approximately 2½ tons of grit a day.

The French Summer Railway Train Services.

THIS year's French summer railway train services present a number of interesting features. To begin with, there are upwards of 180 trains which have booked speeds of 86 kiloms., or, say, 53·4 miles per hour or over. At the top of the list there is the "Rapide" between Paris and St. Quentin, on the Nord, which completes a journey of 153·2 kiloms. in 1 hr. 28 min., or at the rate of 104·4 kiloms. per hour. Putting those figures into British measures, as being more readily understood by some of our readers, they mean that a run of about 95½ miles is made at the rate of 64·874 miles per hour. Actually, there are ten trains which have booked speeds of 60 miles per hour or over, the distances varying in length from 111·9 kiloms. to 253·6 kiloms., or, say, from 69½ to 157½ miles. The second most rapid train on the list is, curiously enough, also a "Rapide" between Paris and St. Quentin, which is down to cover the 153·2 kiloms. in 1 hr. 33 min., or at the rate of 61·39 m.p.h.

The "Sud Express," which plies between Paris and the Spanish border at Hendaye, used to be the most rapidly booked train in Europe for the whole of its journey, and it very possibly still holds that distinction, for its present timings are fast and it completes the whole run of just over 500 miles at an average of approximately 50 m.p.h. including stops. Its fastest section is that between Les Aubrais and St. Pierre des Corps—111·9 kiloms.—which is covered at the rate of 61·33 m.p.h., while its slowest booked speed is 54·56 m.p.h. between Angoulême and Poitiers, a distance of 112·8 kiloms.

The best performances of some of the other trains with well-known names are set out in the following table:—

Train and journey.	Distance, kiloms.	Booked rate, kiloms. per hour.
"Etoile du Nord," Paris-Quéry	234·6	97·0
"Oiseau Bleu," Quéry-Paris	Do.	Do.
"Boulogne-Suisse," Etaples-Amiens	95·7	95·7
"Calais-Suisse," ditto	Do.	Do.
"Nord Express," Jeumont-Paris	237·9	95·1
"Suisse-Boulogne," Amiens-Etaples	95·7	94·0
"Flèche d'Or," Calais-Paris	297·3	93·8
"Engadine Express," Etaples-Laon	202·8	91·4
"Orient Express," Châlons-Paris	172·2	91·3
"Côte d'Argent," Bordeaux-Dax	147·5	89·4

With regard to the last-mentioned train, it may be said, by way of comparison, that the "Sud Express" is booked to cover the distance between the two points named, in both directions, in 1 hr. 37 min., or at a speed of 91·2 kiloms. per hour.

Our contemporary *La Journée Industrielle*, in a recent article discussing these summer services, lays stress on the fact that, in comparing booked speeds on French railways with those on lines in some other countries, it has to be remembered that, by law, French drivers are forbidden to run at a speed in excess of 120 kiloms. per hour. That limit was laid down very early in the history of railways in France, and it is still insisted upon. Indeed, French express locomotives are fitted with apparatus for keeping a record of the speeds at which they are run, and penalties are imposed if it is found that the limit speed has been exceeded. Now, 120 kiloms per hour represent but just over 74·5 m.p.h., whereas, in this country, in the United

States and in Canada, speeds of 10 m.p.h. greater than that, or even more, frequently occur in everyday practice. The limitation to a maximum of under 75 m.p.h. has, naturally, an effect on the average speed, and it is often pointed out by French railwaymen that, if the restriction were removed, much higher average bookings would result. It is, therefore, claimed that the speeds—from start to stop—which are reached in France are really more meritorious than they appear to be on paper. As a fact, a general speeding-up on the French lines has been noticeable during the past few years. In 1929 there were only 67 trains which had average speeds of 90 kilomes.—55·9 miles—per hour. Last year, the number had risen to 85, and this year there are some 100 of them, of which 24 are booked at 95 kilomes.—59 miles—per hour or over. As might be expected, the Nord has the greatest number—50—of these fast trains, while the Est has 24, the P.O. 11, Alsace-Lorraine 8, the Etat 5, and the Midi 2. It is rather curious that the P.L.M. has none.

The Est line, particularly, shows this year some noteworthy advances in booked speeds and in other directions. For example, there are: (*a*) the R3 "Rapide" between Paris and Troyes, a distance of 166·2 kilomes., which does the journey at the rate of 98·7 kilomes. per hour; (*b*) the 30 "Rapide," running from Bar-le-Duc to Paris, with a booked speed of 98·1 kilomes. per hour over a distance of 253·6 kilomes.; (*c*) the R4 "Rapide," which accomplishes the Paris-Troyes trip at the rate of 96·8 kilomes. per hour; (*d*) again the R4 "Rapide," which runs from Belfort to Troyes, 276·5 kilomes., at the rate of 96·4 kilomes. per hour; (*e*) the 34 "Rapide," between Chaumont and Paris, 261·9 kilomes., at an average speed of 96·3 kilomes. per hour, &c. Then there are four long-distance non-stop trains, which run from Paris to Nancy, or *vice versâ*, 352·6 kilomes., in 3 hr. 52 min., or at the rate of 91·2 kilomes. —56·67 miles—per hour. That, our contemporary claims, to be a better record than the 226½ miles—practically 364·5 kilomes.—between Paddington and Plymouth (North-road) in 4 hr., or at the rate of 56·625 m.p.h. As a matter of fact, the trains running in connection with the ocean liners habitually run from Millbay to Paddington, a distance of one mile longer than that between North-road and the London terminus, in the same booked time of 4 hr. Still, the Paris-Nancy booking is a very fine performance, especially in view of the speed restriction referred to above, and it reflects the greatest credit on all concerned.

Referring to the commercial speeds between large centres upwards of 400 kilomes. apart, which are achieved by the various French lines—that is to say, taking the whole time occupied in the journeys without deducting the stopping times, which are sometimes long, especially on the Est and P.O. systems—our contemporary quotes:—

(1) The timing between Paris and Strasbourg—502·6 kilomes.—in 5 hr. 35 min., or at the rate of 90 kilomes. per hour;

(2) That between Belfort and Paris—442·7 kilomes.—at 94·8 kilomes. per hour; and

(3) That between Paris and Bordeaux—587·4 kilomes. —at 87·7 kilomes. per hour. Part of that journey, it may be mentioned, is electrically operated.

Finally, our contemporary remarks that, in addition to improvements in the way of heavier ballasting of the permanent ways, automatic signalling has played its part in rendering increased speeds possible. Particular attention is drawn to the Nançois-Trouville-Lérouville-Metz section on the Est system, on which an automatic system of luminous signalling was recently put into operation and used exclusively.

Modern Machinery and the Design of Large Ships.*

By A. T. WALL and H. C. CAREY.

THE speeds of Transatlantic passenger-carrying vessels are always of importance and interest, and the present paper gives the results obtained by an investigation into the various possibilities.

The particular object of the paper is to show the overall advantage in the complete ship of improvements in modern machinery. The improvements which affect ship design to the greatest extent are (1) reduced weight of machinery and (2) reduced fuel consumption. These are the factors which are dealt with primarily in this paper. Reduced space per horse-power also has obvious advantages, but although of great importance in the design of a particular ship, these advantages cannot be put into figures to cover all cases, but they are referred to in general terms and as necessary. The paper also shows the relation between speed and power, in so far as it is affected by length of ship, displacement coefficient, and weight of hull.

It is axiomatic that increase of weight, whether in hull, machinery, fuel, water, or other items, means loss of speed or increase of horse-power, other things being equal. Reduction of fuel costs on account of reduced consumption can be calculated directly in any given ship, and other economies incidental to the smaller amount of fuel carried can also be assessed without much difficulty. The effect of reduced weight of machinery and fuel, however, cannot be so easily assessed, but is more far-reaching, since it enables a smaller, cheaper, and more economical vessel to be designed, or, alternatively, it gives greater earning capacity for the same expenditure. Between these two limits are endless possible variations, but it is not necessary to consider all of these. They can be deduced from the results given.

The type of ship considered is representative of the modern Transatlantic liner, on service between Southampton and New York, *viâ* Cherbourg. All vessels are of cruiser stern type, of normal form, with the usual arrangement of superstructure decks. In estimating weights, no attempt was made to depart from usual practice with regard to hull and outfit. There is certainly a possibility of weight economy in these items, but this is outside the scope of the paper, although the advantages of it are shown.

Three types of machinery have been selected, the principal variations being in the type of boiler and steam pressures and temperatures. Diesel machinery has not been considered, since the state of its development does not yet warrant consideration for high powers. In all cases the engines are single-reduction, three-stage Parsons turbines on each shaft, with two intermediate-pressure turbines for powers of 30,000 S.H.P. per shaft and over. The closed-feed system, with regenerative condensers, is used for all types, and a vacuum of 29in. is assumed throughout. For the smaller powers, a twin-screw arrangement is taken, and quadruple screws for the larger powers.

The boilers are of three types:—

(*a*) Double-ended cylindrical Scotch, with triple-flow air heaters and forced draught.

(*b*) Yarrow five-drum, double-flow, side-fired, with auxiliary boilers for feed make-up on the Johnson system, quadruple-flow air heaters and forced draught.

(*c*) Johnson two-drum, with auxiliary cylindrical boilers as in (*b*), quadruple-flow air heaters, and forced and induced draught.

Particulars of pressures, temperatures, and efficiencies of the three types are given in Table I:—

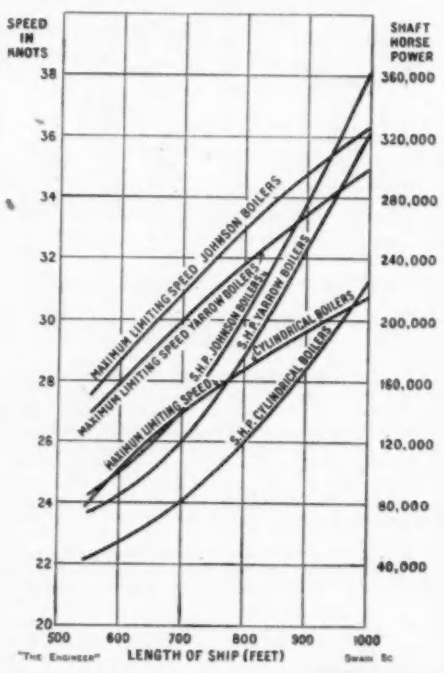
TABLE I.

Type of boiler.	Type A. Cylindrical.	Type B. Yarrow.	Type C. Johnson.
Steam pressure, lb./sq. in.	250	450	450
Superheat in deg. Fah. (° F.)	244	290	290
Final steam temperature, ° F.	650	750	750
Boiler efficiency, per cent.	80	85	87
Feed temperature, ° F.	260	300	300

Other types of boilers, such as the Babcock and Wilcox ordinary and S.X. types, might also have been considered, but sufficient ground is covered by the three types mentioned.

The auxiliary machinery has been varied slightly between the three types, and a description is given in an appendix, together with typical machinery weights and fuel consumption.

Type A represents good modern practice with cylindrical boilers, with moderate pressure and temperatures, and forms the basis of comparison.



LIMITING SPEEDS AND SHAFT HORSE-POWER

Type B represents modern general practice for high-speed ships, except that the boiler ratings have been taken in excess of the usual 5 lb. to 5½ lb. now adopted for marine work. They vary from 6·8 lb. of steam (actual) per square foot of heating surface for a boiler with output of 66,000 lb. of steam per hour to 7·2 lb. in a boiler with an output of 110,000 lb. per hour. The makers recommend these ratings as being well within practical limits without jeopardising reliability.

Type C might be said to represent ultra-modern practice, in that the Johnson boiler is the latest water-tube boiler to be applied successfully to marine propulsion. The ratings in this case are taken as varying from 11·4 lb. to 12 lb. per square foot of heating surface for boiler outputs of 66,000 lb. and 110,00 lb. of steam per hour respectively. These ratings are taken from information supplied by the licensers, Clarke, Chapman and Co., Ltd.

To obtain all the necessary data, ships of various sizes, displacement coefficients, and speeds were considered. Four lengths were taken, each length being used in conjunction with four displacement coefficients of 0·47, 0·54, 0·61, and 0·68, based on length between perpendiculars, and speeds of 20 knots and upwards. Average proportions for beam, depth, and draught were derived from average present practice, and the dimensions, in feet, of the vessels considered are as shown in Table II.

TABLE II.

	Feet.	Feet.	Feet.	Feet.
Length between perpendiculars	550	700	850	1000
Length on water line	572	728	884	1040
Breadth, moulded	74	86	98	110
Depth to uppermost continuous deck	50	56	62	68
Load draught	29	32	35	38

For each combination of length, displacement coefficient, and speed, the horse-powers were obtained by the use of Taylor's Standard Series.

For a fuller description of the method used, reference should be made to a paper entitled "Some Considerations in the Design of Channel Steamers," read before the Liverpool Engineering Society in 1915 by Mr. A. T. Wall.

In order to allow for a working margin the actual horse-power put into any ship was 20 per cent. greater than the net calculated for smooth-water trials. The average service power was taken to be 10 per cent. greater than that for smooth water, and the fuel consumption assessed accordingly. Fuel is carried for the single trip, and taken as 20 per cent. in excess of the total consumption on the basis of service power. A margin of 20 per cent. was also allowed on the calculated amounts of domestic and reserve feed water and consumable stores. The maximum trial power per shaft was taken at 50,000, corresponding to 60,000 for the full power. The limiting power for twin-screw machinery is accordingly 120,000, and for quadruple screws 240,000 S.H.P.

Based on the above, estimates of the total weight of hull and outfit, machinery, fuel, water, stores, passengers, and baggage, crew and effects were made for every possible combination of length, displacement coefficient, speed, and type of machinery, a total of over 200 vessels. Details of the assumptions made in arriving at these weights are given in an appendix. This sum of the weights of these items is called the "total necessary weight," or, more shortly, "total weight." In each case the load displacement was obtained from the length, breadth, draught, and displacement coefficient and curves plotted.

TABLE III.—*Maximum Possible Speeds.*

Type of boiler.	Length of ship in feet.							
	550.		700.		850.		1000.	
	Kts.	Power.	Kts.	Power.	Kts.	Power.	Kts.	Power.
Cylindrical*	24·2	42,000	26·9	80,000	29·0	141,000	30·8	226,000
Yarrow	26·8	72,000	30·0	120,000	32·6	210,000	34·9	323,000
Johnson	27·5	80,000	30·8	141,000	34·0	239,000	36·4	362,000

* NOTE.—The maximum possible speed of 30·8 knots cannot be obtained with cylindrical boilers on account of space limitations.

Table III. has been produced from the curves and shows the maximum possible speeds—maximum limiting speeds—with the corresponding horse-powers, for the four lengths and the three types of boilers.

It will be seen that the maximum possible speeds naturally increase with size, and by about 6½ knots for the cylindrical boilers in going from a length of 550ft. to 1000ft. This is only an increase of about 27 per cent. in speed for an increase of about 82 per cent. in length and about 300 per cent. in total displacement, to say nothing of about 440 per cent. in horse-power. For the same lengths the maximum possible speeds increase by about 8 knots with Yarrow boilers and by about 9 knots with Johnson boilers. The accompanying curves show maximum limiting speeds and corresponding shaft horse-power.

As an indication of the excessive cost of speed, as maximum limiting speeds are approached, it is shown that to reach 34·9 knots in a 1000ft. ship with Yarrow boilers, 323,000 S.H.P. is needed, while 34·2 knots may be obtained with 240,000 S.H.P. So that for 0·7 knot increase of speed, equivalent to 2·05 per cent., an additional power of 83,000 S.H.P., or 34·6 per cent. is needed. In this instance, the shaft horse-power is increasing at nearly the fifteenth power of the speed.

Taking a more extreme case, it is shown that for a 1000ft. ship with Johnson boilers, a speed of 36·2 knots may be reached with 319,000 S.H.P., as compared with 362,000 S.H.P. at the maximum limiting speed of 36·4 knots. This last one-fifth of a knot requires 43,000 S.H.P., and in consequence the shaft horse-power is increasing at about the twenty-third power of the speed. The form of the limiting speed curves show that for very small reductions in speed, the shaft horse-powers may be reduced by substantial amounts, but that the flat nature of the curves near the maximum speeds makes it difficult to obtain accurate numerical results.

The results obtained in the paper should not be applied to any particular ship without careful consideration. The subject has been treated in a general way in order to cover a large field. All lengths, coefficients, speeds, horse-powers, and deadweights are correctly related throughout, so that all ships dealt with may be regarded as properly balanced designs. Treatment over a smaller range can be carried out in the same manner, with more refinements introduced. The inclusion of minor variations would not add to the value of the results obtained, and the treatment adopted illustrates the points with very good accuracy. The necessity for the detailed study of individual cases still remains. There is no doubt that the problem of design well repays careful study. The results of the investigations are summarised in the following paragraphs. When the word "ship" is used, it refers to ships of the type and for the trade described in the paper.

(1) With length limited to 1000ft., the maximum speed that could be reached, if the necessary power could be transmitted through the machinery, is about 36½ knots. With present-day limits of transmission of power, the maximum speed with quadruple screws and 240,000 total S.H.P. is about 35 knots. These speeds can only be obtained by the use of Johnson boilers, giving a machinery weight corresponding to about 22 S.H.P. per ton. The corresponding speeds with Yarrow boilers are about 35 and 34 knots respectively.

(2) The maximum horse-power likely to be installed in large liners will not exceed 240,000 S.H.P. for some time to come on account of transmission limitations.

(3) Modern steam producers are so efficient that space can be found in any ship for the necessary boilers to drive her at her maximum possible speed.

(4) Cylindrical boilers will limit the maximum possible speeds for ships of lengths greater than about 855ft., since the available space is insufficient to house the boilers, although the necessary weight could be carried on these lengths.

(5) Generally higher speeds are obtainable and maximum possible speeds are greater with modern steam producers than with the old, varying from 3·3 knots increase in a 550ft. ship to 5·6 knots in a 1000ft. ship, in changing from cylindrical to Johnson boilers.

* Abstract of paper read at the Summer Meetings of the Institution of Naval Architects, in Paris, July 2nd, 1931.

(6) It is most uneconomical to drive a ship at her maximum possible speed with any type of machinery.

(7) For a given speed and deadweight there is a minimum length of ship coupled with a certain power, and a minimum horse-power coupled with a greater length. The most economical ship will have a length and horse-power between these two values respectively. These values can be found by the methods given.

(8) Higher speeds must involve longer and larger ships for the greatest overall economy, and the initial and running costs increase quite out of proportion to the percentage increase of speed.

(9) Appreciable economy is obtained by reducing weight, whether in hull, machinery, or fuel per shaft horse-power.

(10) Modern machinery permits the adoption of smaller displacement coefficients than with the old, giving improvement in performance at sea.

(11) Modern machinery enables size and horse-power for a given deadweight and speed to be reduced. In the paper, a particular case is quoted with reductions of 24·8 per cent. in length, 50 per cent. in hull cost, and 34·4 per cent. in horse-power and fuel consumption.

(12) With modern machinery minimum hull dimensions for given conditions more nearly approach those required for minimum horse-power, so that the loss by the necessary compromise is reduced.

(13) Modern machinery will affect hull design, since to carry the same number of passengers as a larger ship with old machinery, superstructures will be increased. Passenger accommodation will therefore generally be higher in the ship and consequently better.

(14) Modern machinery enables greater speeds to be obtained on the same draught—a definite advantage when related to the limitation of depth of water in some harbours which cannot be deepened without considerable expense.

(15) Generally, great economies are possible with the use of modern machinery, both in first costs of hull and machinery and in running.

In conclusion, it is apparent that while much has been said, a good deal has been omitted in order to keep the paper within reasonable limits. A large number of diagrams are produced, but many others might have been included. Investigations similar to those described should be made when any new design is under consideration. It is not sufficient to improve upon an existing ship, which may not provide a good basis. Similar treatment can be applied to all types of ships. To complete the study, first and running costs should be connected with the data, but it was impossible to deal with this aspect in an adequate manner in this paper. It is economy which makes progress possible, and modern machinery is essentially economical in all ways.

THE MOTOR CAR INDUSTRY.

WE learn from the annual report—price 2s. 6d.—of the Society of Motor Manfuacturers and Traders, which has just been issued by the Society that—

(*a*) The average life of a motor vehicle in Great Britain is now 7¾ years;

(*b*) Whilst motor cars and taxis have increased by nearly 300,000, the proportion of street accidents attributable to these vehicles has decreased by 1·6 per cent.;

(*c*) The United Kingdom still pays the highest taxes in the world, viz., £27·9 per vehicle per annum, as against £6·56 in the U.S.A.;

(*d*) Production in 1930 was 61 per cent. higher than in 1924;

(*e*) Employment in the motor trade in 1930 was 8·9 per cent. higher than in 1924;

(*f*) There has been a favourable balance in overseas trade of all motor products since 1926;

(*g*) The British Empire owns 11·3 per cent. of the total vehicles in the world; and

(*h*) There are 29·8 persons to every motor vehicle in the United Kingdom and 4·6 persons to every motor vehicle in U.S.A.

Many attempts have been made to devise a formula which would rank different countries in their proper order as motor users, and at the same time give some indication of their remaining potential absorption. The Society offers the following: $25-\frac{V^2\times 10}{P\times R}$ = degrees from saturation point, where V = number of vehicles, P = population, and R = the length of surfaced roads. This formula assumes that saturation is reached when there is one vehicle to every four persons and ten vehicles per mile of surfaced roadway. From its use it appears that the United States is less than 6 deg. from saturation and the United Kingdom 22 deg. The other leading nations of the world are all in the twenties. It is suggested that the formula is equally valuable when dealing with an internal domestic market, although in that case it might be desirable to change the standard of 25 to a figure based on the most highly developed district.

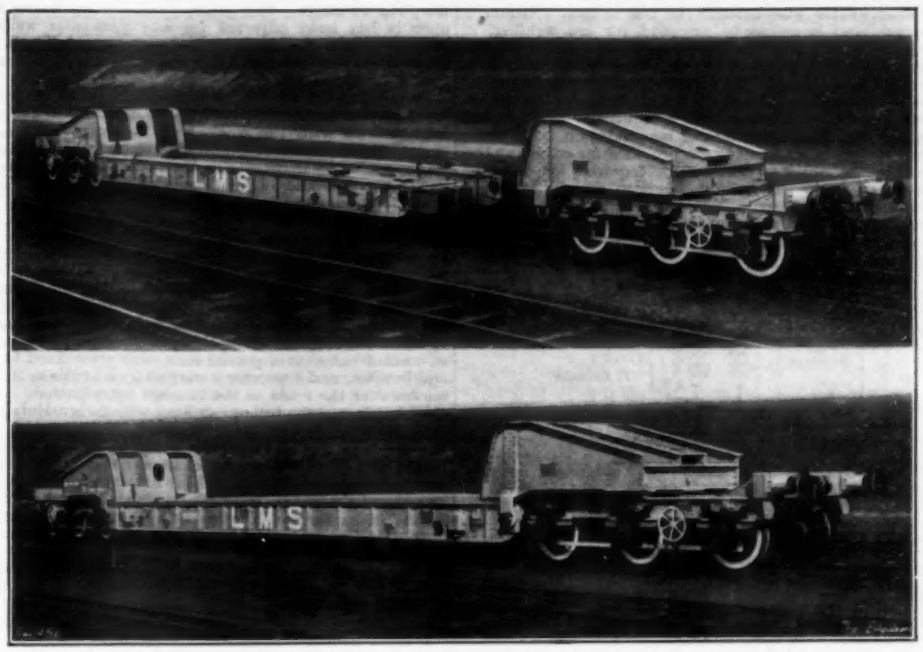
The report contains the usual interesting tables and graphs.

SIXTY YEARS AGO.

IN our issue of July 14th, 1871, we published the names of the fifty successful candidates for admission to the newly established Indian Civil Engineering College at Cooper's Hill, Surrey. Tenth on the list we find the name of Mathew Henry Phineas Riall Sankey. (He apparently did not enter the College, in spite of his success at the examinations, for in the same year he entered the Royal Military Academy, and two years later he received a commission in the Royal Engineers.) In a leading article we discussed the prospects of the new College as a training centre for the engineers required by the Indian authorities. We welcomed it as a step in the right direction—there had been previously many grounds for complaint concerning the treatment of civil engineers in India—but we doubted whether the College would be able fully to carry out its scheme of education. That scheme covered not only instruction at the College, but a period of six or nine months during which the pupils were to be articled to a civil engineer in practice. Many engineers, we said, refused altogether to take pupils, finding them in general more trouble than they were worth. Some would accept them for three to five years on payment of a premium. Very few, we thought, would consent to take pupils from Cooper's Hill on the terms proposed by the College. . . . India and another Royal Engineer officer, Colonel R. E. Crompton—happily still with us—are recalled also by our second leading article in the same issue, an article dealing with india-rubber *versus* iron tires for tractors. It was in India that Lieut. Crompton had made his celebrated road train experiments, and arising from an article which he contributed to our columns, a prolonged discussion ensued between the opponents and supporters of rubber tires. At the Royal Agricultural Society's Show held in 1871 at Wolverhampton the controversy had been put to what was believed to be a final test. The trials were held to provide a final answer. On wet, soft ground rubber tires had utterly failed, but on a macadamised road they incontestably demonstrated their superiority. The trials were rendered possible by the action of Ransomes, Sims and Head, who sent to the Show a traction engine, the "Sutherland," fitted with rubber-tired wheels, and provided with a pair of smooth-faced cast iron wheels of the same size as spares. The engine was driven up a known incline first with the rubber-tired wheels, and then with the iron wheels. With the rubber tires the engine showed itself capable of taking a gross load of about 38 tons up an incline of 1 in 18. With the iron wheels it refused to ascend with a gross load of 28 tons.

WAGON FOR TRANSPORTING LOCOMOTIVES

MR. E. J. H. LEMON, DERBY, ENGINEER



A Wagon for Locomotives.

Two railway vehicles of unusual construction have just been built to the designs of Mr. E. J. H. Lemon, chief mechanical engineer of the London, Midland and Scottish Railway, to provide a convenient means of transporting locomotives of gauges other than the English standard. One of these wagons is illustrated above. They are each capable of carrying locomotives up to 65 tons in weight having any gauge from 3ft. to 5ft. 6in.

The object aimed at in the design of these wagons is to enable the locomotives to be run on to them, on their own wheels, at the makers' works and run off again at the quayside on to an accommodation siding of appropriate gauge. The engine can then be lifted directly into the ship's hold by the ship's own derrick. In this way the services of a floating crane, the usual method of such transhipment, is avoided.

For such an operation it is obvious that the engine must be run on endways, but it is also necessary that a gondola-type of car should be used on account of loading gauge restrictions. These two conflicting requirements have been overcome by Mr. Lemon in a most ingenious way. The platform carrying the locomotive is detachable from its supports and bogies, so as to leave the end free to join up with the rails of the siding.

The platform is built up of two heavy box girders in the centre and two I section side frames, with, of course, appropriate cross bars. Bridge rails are laid on these bars and can be moved to suit the gauge of the locomotive to be carried. At either end of the platform there is attached a cantilever section to transfer the load on to the bogies. The cantilever is made of steel pressings and cross bars, and its form is plainly shown in the engravings. It is attached to the platform by large turned bolts, while the heel rests on steps on the top flange of the girders. The cantilevers are supported by the bogies by means of standard steel centre castings and pins. The bogies are of the normal six-wheeled type, and are so arranged as to give an equal loading on all axles. They are provided with powerful hand screw brakes, which give an equal block pressure on all six wheels, and have appropriate draw and buffing gear. The buffers are of the self-contained compound type. A tool-box is fitted on one of the bogies.

When the vehicle arrives at its destination the load is taken off one, or the other, of the cantilevers by means of hydraulic jacks under the platform bearing on the rails. These jacks are worked by hand pumps on the side frame, and have ratchet return gear with safety catches to prevent the rams falling of their own weight when the vehicle is running. The cantilever is balanced on its bogie by means of screw gear and the connecting bolts can then be withdrawn. The bogie and cantilevers are hauled away and the end of the platform left free for the locomotive to be run off.

It is, of course, necessary to get the detached bogie out of the way before the locomotive can be run off the platform, so a short spur line is arranged at the terminus. The bogie is hauled out on to this spur and then a ramp is put in place to connect the rails on the platform with those of the special siding. This ramp is built up of structural steel in sections, so that it may be easily handled and is about 56ft. long. The various sections are connected together by means of fish-plates and simple connections. We understand that the whole operation of unloading a locomotive can be carried out in 1 hour. The onloading at the makers' works involves a practically similar operation, but, naturally, is determined by the facilities available.

The following are the principal dimensions:—

Length over buffers	75ft. 1in.
Length over headstocks	72ft. 1in.
Centres of bogies	58ft.
Length of well	40ft.
Width over connecting pins	8ft. 4in.
Width over side beams	7ft. 6½in.
Height to top of side beams	2ft. 10⅜in.*
Height to top of centre beams	2ft. 3⅜in.*
Height to top of trolley rail	1ft. 9⅛in.*
Height to underside of main beams	7⅜in.*
Diameter of wheels on tread	2ft. 8½in.
Size of journals, diameter	11in. by 5½in.
Tare	49 t. 8 c. 2 qr.

* Loaded.

LIFT SERVICE FOR CAVERN VISITORS.

AN extensive ramification of vast caverns in New Mexico was discovered a few years ago, and proved to be of such importance that the site was acquired by the United States Government and established as a national park. The principal features are the great size and height of the chambers and the wonderful stalactitic effects. For the benefit of the crowds of visitors, the Government has built trails and pathways, but access to the entrance involves some heavy climbing. For greater convenience of access, a shaft is to be sunk from the surface to the main cavern floor, a depth of 750ft., with a cross section 14ft. by 7ft. inside the concrete lining. Two electric lifts or elevators, 5ft. by 6½ft., each carrying twenty persons and driven through worm gearing by a 60 H.P. motor, will work in the shaft. They will be entirely independent, and each completely self-contained, so that one can be used alone when traffic is light or when the other requires inspection or overhauling. The speed will be 750ft. per minute. Over the shaft will be an ornamental concrete building for the machinery, ticket office, waiting room, restaurant, and other facilities. The rock formation is so honeycombed with caves and cavities that the shaft is expected to intersect some of them before reaching the main cavern level. In such openings steel framework or towers will be built for the attachment of the guide rails of the elevator cages and the counterweights. The tops and bottoms of these towers will be concreted into the solid rock of the shaft above and below. Hard and sound rock is expected to extend most of the way, and this will require only a gunite facing to shape the shaft to finished dimensions. Where loose or soft rock is encountered, the excavation will be enlarged and lined with reinforced concrete. The excavation will be started both from the top and from the cavern at the bottom.

The Burke-Scott Electric Welder.

DURING a recent visit to the works of Laurence, Scott and Electromotors, Ltd., of Norwich, the Burke-Scott electric welder was brought to our notice. Although the machine is primarily intended for arc welding, it may be used for other purposes that call for similar operating characteristics. From the diagram of connections—Fig. 1—it will be perceived that the generator is provided with a set of main shunt-wound poles and series-wound poles, alternating with each other. The brushes are placed so that the line of commutation is opposite the series poles, and means are provided for adjusting the brushes according to the output required for different classes of work. The shunt windings are excited from auxiliary brushes in a line of commutation between poles of opposite polarity, and in such a relationship

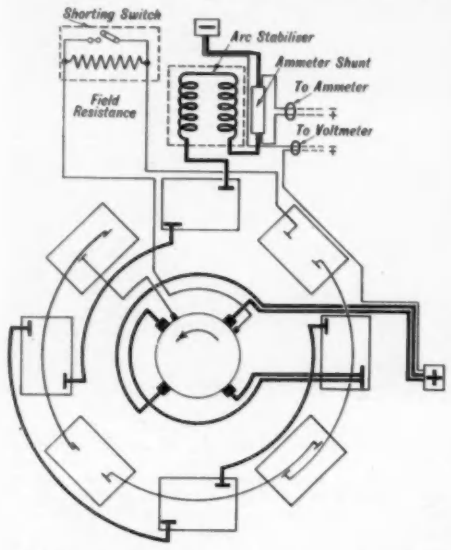


FIG. 1—ELECTRIC WELDER CONNECTIONS

to the armature fields as to cause the interactions between the different fields to give the desired regulation.

The machine may be regarded as one in which the main pole parts are split into two parts, one part being shunt-wound and the other series-wound. The series winding is so proportioned that the correct curve is obtained if the main brushes be placed anywhere within the zone of the poles, which are sufficiently wide to permit of a large range of brush positions, and by giving more or less lead to the main brushes, it is possible to vary the amount of de-compounding effect from the series winding as desired. As the shunt winding is fed from the auxiliary brushes, placed so that the turns between them are cut by the sum of the flux from the two parts of the main poles, it has approximately a constant voltage across it, and the machine is, therefore, equivalent to a separately excited dynamo with an adjustable amount of negative compounding.

It is necessary in electric welding when the work is of a varied character and has to be done on materials of

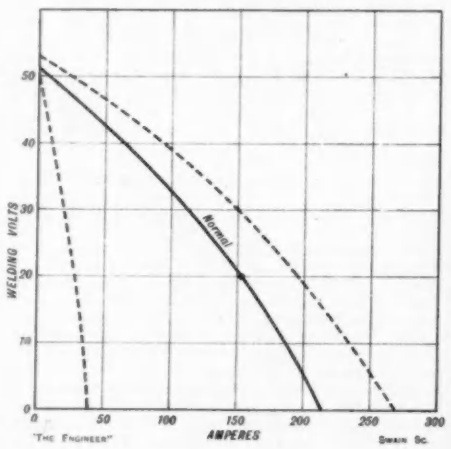


FIG. 2—CHARACTERISTIC CURVES

various kinds, to be able to adjust the output to meet specific requirements. For the best results some kinds of work may require, say, 50 ampères, whilst work of a different character may call for, perhaps, 200 ampères. Intermediate current values may be desirable for other kinds of work; in fact, the requirements are so variable and the welding operation so sensitive to different current values, that it is essential not only to have a wide range of adjustment, but also to be in a position to make adjustments to a high degree of refinement. Frequently, these adjustments are obtained either by providing adjustable resistance devices in the main circuit, or by providing the fields of the generator windings with a number of tappings. The makers of the machine under consideration point out, however, that the first method is objectionable, because of the waste it involves, whilst the second method is unsatisfactory because of the comparatively few steps it provides, and also on account of the auxiliary apparatus necessary for giving the adjustment. The Burke-Scott welder obviates these objections, for it is capable of an infinite number of adjustments of welding current for different classes of work, this being accomplished by a simple movement of the main brushes without any auxiliary controlling or adjusting devices. No separate exciter or outside source of supply is needed for exciting the field windings. The generator is self-regulating and once it has been adjusted for any particular welding current it will regulate in such a way as to fulfil all the requirements of arc welding and will maintain stable operating conditions.

In striking the arc the voltage should be high enough to cause a current to flow when the electrode is brought into contact with the work, that is, somewhat greater than the normal current required for the welding operation. As the arc varies in resistance, the voltage of the generator varies correspondingly, and maintains the current at a practically constant value best suited to the work. The generator gives all the desired variation by combining the external reactance with the internal reaction in the generator, the degree of which can be predetermined. For any particular type of weld the machine is self-regulating and can be adapted for obtaining different current values for different kinds of work by a simple adjustment of the main brushes, and good commutation is maintained under all working conditions. The range of current values is engraved on a scale plate fixed to the end bracket, and a pointer is carried by a brush so that it moves over the scale as the brushes are adjusted. Over the whole range the full arc striking voltage is maintained.

When welding with bare electrodes, it is essential that the machine should respond quickly to sudden changes of the arc. The volt-ampère characteristics of the Burke-Scott welder are well adapted for bare electrodes, as well as covered electrodes, and no main resistances are required for stabilising the arc. The curves in Fig. 2 show the normal output and range available. The generator can be driven by a constant speed electric motor, or other source of power, the usual equipment consisting of a combined motor and generator mounted on a heavy rolled steel welded frame.

A New Type of Pivoted Sidelight.

IN the past few years there has been a noticeable increase in the adoption of the pivoted type of sidelight for ships, partly on account of the fact that with this particular form of hull fitting the glass holder can be arranged to act as a wind scoop and partly because when in the open position the glass holder, if struck by a wave, would be automatically pivoted into the closed position. In earlier designs of pivoted sidelights, the glass holder

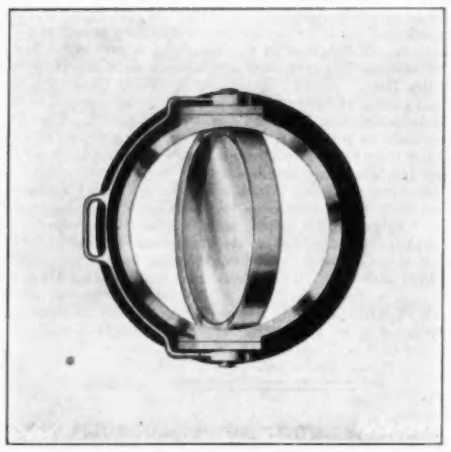


FIG. 1—STIRRUP SIDELIGHT

was rendered water-tight by clipping it to a ring by means of fasteners or by the more complicated syatem of wedge fastenings. In view of the increasing popularity of the pivotal sidelight, the firm of J. Stone and Co., Ltd., of Deptford, has recently designed a new pattern of fitting, known as the "Stirrup Sidelight," which will shortly be put on the market. It is illustrated in Fig. 1 herewith, and some details of its construction are indicated in Fig. 2. The sidelight is named the "Stirrup" light because its principal feature, the operating handle, takes the form of a stirrup. The two main parts are the glass holder and the fixed frame in which it pivots. In order to ensure water-tightness, a rubber seating ring is fitted on the face of an inwardly projecting ring on the inboard side of the fixed frame. It may be noted that any outside pressure which may be exerted by the water merely tends to increase the water-tightness of the joint. Instead of the more usual clip or wedge fastening arrangement, the glass holder is brought into position and is held firmly against its seating by the simple operation of pushing the stirrup shaped handle into a position flush with the fixed frame. Should it be desired to open the light, the handle is pulled forward and swung completely across the light in a semi-circular path. This movement operates cams at the top and bottom of the sidelight—see Fig. 2—each of which carries a pivot of the glass holder. When the stirrup handle has completed its travel, the glass holder is then free to turn on its axis. In this position the glass holder is free to move on its supporting pivots, but if it is desired to lock it in any given position, this can be easily done by a short return pull or forward movement of the handle, which locks the glass holder by wedging its outer edge against the smaller diameter of the inner edge of the frame. If the glass holder is to be left free to pivot the handle is retained in the open position, but a full return movement to the opposite side of the frame locks the glass holder, making a water-tight joint, as previously described.

Our illustrations show the side light with the operating handle, both in the open and closed positions. It may be stated that the stirrup handle can be designed to operate in either direction, either opening from right to left and closing from left to right, or the opposite way. As our drawing shows, should the glass accidentally become broken the glazing ring is so designed that a new one can quite well be fitted without having to remove the glass holder itself from the frame.

The new side-light is quite neat in its appearance, it

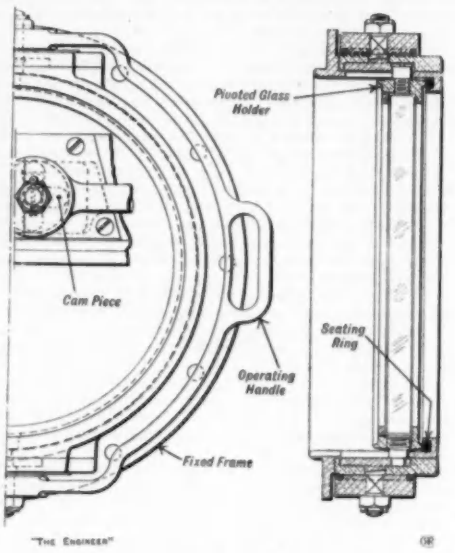


FIG. 2—SIDELIGHT DETAILS

is simple in its construction, and easy to operate. It forms a further addition to more than sixty different forms of ship's windows and sidelights, which, we are informed, are now manufactured by the firm.

South African Engineering Notes.

A Rail Car Service.

THE opening of the railway line from Kimberley to the rich manganese ore field at Postmasburg, not far from Koopmansfontein, has had the effect of causing considerable developments in that important industry. Prior to the construction of the railway, the Railway Administration operated a road motor service between those two points, carrying goods and passengers. But with the railway now carrying great and increasing quantities of manganese, there has been a demand for the provision of passenger transport also, and the Administration has introduced a rail car service over the new line. The rail car makes the trip in both directions every week-day, covering the 130 miles in six hours, this time including 74 minutes for stops. The car provides accommodation for thirty-nine passengers as well as for a limited quantity of baggage.

S.A.R. Motor Repair Depot.

The South African Railways Administration has found it necessary in view of the enormous growth of the road motor services which it operates in the Midland area of the Cape Province to erect up-to-date workshops at Port Elizabeth. These workshops will be fitted with plant and equipment that will enable them to deal with all necessary repairs and replacements to vehicles. At the present time, the mechanical staff in the workshops has at hand facilities that permit of the complete stripping and reassembling of both engines and chassis, and consequently all vehicles in the area that require structural or mechanical repairs can be accommodated. Extensive garages have been erected, and sufficient space is available for the housing of all locally operating omnibuses, as well as those sent in for repairs. When the workshops are finally equipped, repairs and renovations to bodies will be made possible, and the Administration will be able to carry out all necessary repairs and alterations with a minimum of delay and by its own staff. Provision is being made for the overhaul of rail cars in a special siding attached to the workshops.

Algoa Bay Harbour.

The estimates of capital expenditure on railway and harbour works for 1931–32, recently issued by the Government, show that while there has been a severe pruning on all capital expenditure, and no new substantial Vote appears for any of the Union harbours, Port Elizabeth has had allocated to it a total sum of £330,000 to be spent during the coming year on works and services. Of this amount, the largest single sum is £100,000 for the construction of the South Breakwater, which forms part of the Algoa Bay development scheme, or, as it is now known, the Craig Harbour Scheme. As indicating the Government's intention with regard to the harbour in future, a sum of £32,745 is put down for the provision of water-borne sewerage at the harbour, £17,636 for temporary pre-cooling facilities, and £14,760 for the new tug "St. Croix." The estimates of expenditure on capital and betterment works for the whole of the Union provide for an expenditure on the construction of railways of £152,340—a decrease of £316,786 compared with last year. The estimated expenditure on new works on open lines is £2,174,475, compared with £2,441,914 last year. The estimated expenditure of £309,499 on rolling stock represents a decrease of £500,923. The only increase shown is under the head of Harbours, on which it is

estimated £566,980 will be spent in comparison with £463,556 last year. The gross total is £3,564,965, compared with £4,688,382 in 1930–31, a decrease of £1,124,317. The 1931 construction programme embraces only three new lines. It is estimated that £60,000 will be spent on the construction of a loop line from Kleinstraat to Matroosberg, £10,000 on a loop line from Northam to the vicinity of Kwaggashoek, and £9000 on a line from Durban Point to Congella.

Grain Elevators.

The chain of grain elevators erected through the maize belt of the Transvaal and Orange Free State with terminal structures at Durban and Cape Town, constitutes one of the South African Railway's most important developments in the fostering of South Africa's farming industry. During the current season, up to May 9th, the quantity of maize and Kaffir corn handled in the grain elevator system amounted to 560,412 tons. That figure constitutes a record for any one season, being 42,000 tons in excess of the previous highest total. By far the larger proportion of the grain that finds its way into the elevators is exported overseas, shipments going principally to Europe and Canada, and of this year's total, nearly 440,000 tons were exported from South Africa through the ports of Durban and Cape Town, while of the remainder, some 80,000 tons was distributed for local consumption.

New Power Plant at the Globe and Phœnix Mine.

The new power plant at the Globe and Phœnix gold mine, Southern Rhodesia, will be completed in twelve to fifteen months, and will effect substantial economies in the cost of operation. It will include two direct-coupled Premier Crossley gas engines and air compressors, each of 1710 c.f.m. capacity and each with one high-pressure and two low-pressure cylinders. It is to be remarked that this is the first occasion on which compressors directly coupled *vis-à-vis* to gas engines has been constructed, and the operation of the plant will, therefore, be watched with very considerable interest. In addition to the installation of this compressor plant, the hoisting equipment at the mine is being electrified. The maximum vertical depth attained in the mine at present is 3200ft. A subsidiary haulage which will enable mining operations to be eventually carried on down to a maximum vertical depth of 7000ft. is being installed.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Midsummer Quarterly Meeting.

THE midsummer quarterly meeting of the Midland iron trade was held in Birmingham to-day—Thursday—and was well attended. Representatives of firms from many parts of the country, including a goodly number from South Wales, gathered together in the hope of being able to gauge to some extent the probabilities of trade from and with this district over the next three months. Although the market itself did not provide any evidence of a general expansion of demand, there appeared to be a hope of increased vitality in one or two departments. The underlying movements were not sufficiently strong, however, to permit of definite expectations. Business in all branches of the market was pursued with caution, producers and consumers alike having been rendered careful by the past months of inconstant and fickle trade. The past half-year has, indeed, been a trying one for Midland industrialists, and business has been only a shadow of its former self. It is doubtful if a solitary concern has been able to produce up to capacity, and recent returns of a year's trading show that in most instances, poor as business was during the latter half of last year, it has been worse since. Fortunate are the firms which can count upon a profit on the workings of the past six months. A contracted volume of trade has led to lower selling prices, despite the fact that overheads have, if anything, risen. Many industrialists believe that at last the deflation of iron and steel values has reached its limit, for some materials, it is held, are being sold at below the cost of production. With any revival of demand, prices will advance, and as the downward trend of trade is believed to have reached its lowest level, producers of iron and steel are looking forward to a more remunerative level of prices during the next half-year. Even when this desired state of affairs begins to manifest itself, it will take some time for iron and steel masters to realise the economies accruing from full-time working of their plant. Unfortunately, engineers and manufacturers on 'Change this week were unable to speak with confidence of the future. They hope for better times and they believe they are coming, but they have no tangible testimony of increased activity at the works in the immediate future. Inquiries they say are improving, and lead to some confidence in a growing consumptive demand, but their hopes have been shattered so many times of late that they hesitate to rely upon evidences so indefinite. Conversations at the quarterly meeting revealed that the iron and steel trades in this district are poorly off for work, and that practically all branches of engineering are more or less depressed, not excluding the automobile industry. The Staffordshire chain trade is in a bad position, while tube makers, with a few exceptions, are not free from anxiety. The heavy edge tool trade is in distress, and right throughout the Midlands and Staffordshire a more economic employment of productive resources has become essential. An improvement in trade is long overdue, but there is an increasing body of opinion having confidence in the future. It cannot with truth be said that to-day's quarterly meeting was a bright affair, or that any considerable volume of business was transacted, but it is safe to assert that the market tone was brighter than of late and that the inquiries in circulation were such as to raise hopes of improved industrial activity in this area during the current quarter.

Poor Demand for Iron.

Midland forges and foundries, being short of work, there is a very poor demand for Derbyshire and Northamptonshire pig iron. Orders placed to-day were, as of late, for very small tonnages and there was practically no forward buying. Times were when at the quarterly meeting consumers booked up their supplies over the whole quarter. Now they take no more than a week's requirements. This time last year little business in pig iron was being done, consumers contending that prices were far too high. To-day, Midland brands of raw iron are 12s. 6d. per ton cheaper than they were then; but the consumptive capacity is very limited, and again, at the Midsummer meeting, little business was transacted. There being little prospect of any alteration in price during the current month, interest in the market was naturally limited. Stocks of iron at the blast-furnaces do not appear to be increasing much. Derbyshire smelters find an outlet for their production in the pipe foundries, while Northamptonshire blast-furnacemen are still able to dispose of some of their production outside the area to which fixed prices apply. Although this business is not as remunerative as that done on this market it enables smelters to keep down their stocks. During the past twelve months the Pig Iron Producers' Association has held solidly together despite trying times, and its minimum level of prices is not disputed. Derbyshire and North Staffordshire No. 3 foundry irons now stand at £3 6s. per ton, and forge grades at £3 1s., while Northamptonshire material is £3 2s. 6d. and £2 17s. 6d. for foundry and forge brands respectively. District foundries are quieter than is usual at this time of the year, while the forges are very poorly employed, indeed. The outlook in neither branch is rosy.

Staffordshire Trade Depressed.

The past quarter has not infused new life into the finished iron trade in Staffordshire. At this time last year I wrote: "It is difficult to see how they [ironmasters] are to carry on until the trade revival sets in." The year has been one of great difficulty, yet still to-day, Staffordshire ironmasters hang on tenaciously. A few orders coming in from day to day enable work to continue, but the mills cannot operate for more than about three days per week. There are few encouraging signs, and the spirits of ironmasters are depressed. Marked bars, which, to-day, sell at £12 per ton, are 10s. cheaper than they were a year ago, yet sales are smaller. Crown bars now obtainable at £9 5s. commanded £10 twelve months ago, and nut and bolt bars are £8 10s. as against £9. Wrought iron gas tube strip has had a fairly good run of business, but values in this department have also fallen, to-day's figure of £10 12s. 6d. comparing with £11 2s. 6d., the prevailing selling rate last midsummer. There is no alleviation of the keen competition existing in the merchant and common bar branches, and the large disparity in price outweighs the inferiority of quality.

Steel.

Buying of steel was not stimulated by to-day's quarterly meeting. Mills are badly in need of specifications, but consuming engineers are only able to take moderate tonnages, as they have but few orders on their books, and they are of small size. Steel manufacturers from this district do not claim to see signs of recovery in trade. In no branch, they say, is there any evidence of growing demand. Consuming industries in the Midlands are all suffering from lack of business and inactivity at the works limits production at the mills. Chief interest in the steel market at date centres round semi-finished material. Here, selling prices are a matter of bargaining and, as quotations for continental material are advancing, alterations in local producers' selling rates are anticipated. The recent slump in continental values brought down native quotations, and it is only reasonable to suppose that British half-product values will follow upwards those of foreign manufacturers. The market tone in this branch has been stronger during the week, but up to the time of writing there has been no appreciable alteration in quotations. Small bars re-rolled from continental material varied in price from £6 7s. 6d. to £6 10s., while soft billets were quoted £5 upwards. The weakness of steel scrap continues and values are indeterminate.

Galvanised Sheets.

There has been some speculative buying of galvanised sheets, as there is a possibility of values advancing. Business is much as it was a week ago, and local mills have room for considerably more orders. The call for black sheets is not up to normal.

Unemployment.

The number of unemployed in the Midlands has been increased during the week by 23,627, bringing the total to 425,637. The figure is higher by 150,373 than it was in the corresponding week last year. Of the workless 302,508 are men, 106,437 women, 9374 boys and 7318 girls. In Birmingham, where the figures continue to rise, there are now 69,306 unemployed, at Coventry 17,193—also an advance on last week—Stoke-on-Trent, 38,349, against 36,307 a week ago; Leicester, 17,100; Nottingham, 16,350; Wolverhampton, 14,008; Walsall, 11,325; Cradley Heath, 9286. The Black Country towns, with the sole exception of Oldbury, all show advances on the week.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Heading for Better Times?

FOUNDRY iron sellers on the Manchester Royal Exchange have recently reported a better demand for their product, and whilst that cannot be attributed wholly or even largely to greater activity at Lancashire foundries—the market view is that a growing belief in the stability of pig iron prices is primarily responsible for users adding to stocks—the fact that one or two textile machinists have had more work in hand has had something to do with the spurt. Mr. E. V. Haigh hinted at the prospects in this imoprtant branch of Lancashire engineering in the course of his address as chairman at the annual meeting of John Hetherington and Sons, Ltd., machine tool makers and textile machinery manufacturers, Manchester. He stressed the point that whilst the experience of the company during the last year or two did not tend to develop optimism, it had at the moment a better order book for textile machinery in general than at any time during the past financial year, and in the three months to the end of June the company had received as many orders for combing machines as it booked in the whole of the preceding twelve months.

Steel Corporation's New Plant.

A formal start on the erection of the large coke oven installation at the works of the Lancashire Steel Corporation at Irlam was made on Thursday of last week. This plant forms part of the Steel Corporation's important development programme, which, besides the construction of a new dock on the Manchester Ship Canal, includes also the erection of extensive blast-furnace and rolling mill plant. Sir Arthur Duckham, chairman of the Woodall-Duckham Company, was present at the ceremony of the laying of the first brick.

Rationalisation Perils.

Sir Arthur Duckham, by the way, in his capacity as President-elect of the Federation of British Industries, had something to say on the question of rationalisation when addressing the members of the Manchester Branch of the Federation on Monday of this week. He questioned whether there was anything more inefficient than the large semi-idle factories of the United States, Germany, and France. We in this country, he said, should be glad that we had not, after the war, the money to build these huge units of production which were such a weight on those countries to-day. Great Britain would go forward on much saner lines with smaller units of production, with the real personal element running through them. The inefficiency of rationalisation was better seen to-day than it could have been in any other circumstances, and he thought it should be taken as a warning here. "Rationalisation is a road to nationalisation, because the colossal unit can be easily switched from one thing to the other."

Non-ferrous Metals.

Reaction of varying degree has been witnessed in most sections of the non-ferrous metals market during the past week. Tin has been the one exception, for at the time of writing a notable recovery has been made after the previous week's setback. Copper, on the other hand, has been the principal sufferer, and in this section the whole of the gain of the last two weeks of June has been more than wiped out. In the case of tin, whilst buying can only be described as of moderate extent, there is a belief that the new output restriction programme will prove effective, and whilst the statistical position continues to be adverse, the latest official returns relating to visible supplies, in contrast to the experience of the past twelve months, show no appreciable addition to stocks. Prices of the metal are higher on balance for the week by from £3 10s. to £4 a ton. A heavy turnover has been reported in copper, but a very large proportion of the demand was on speculative account. At one time, prices registered an appreciable advance, but there has since been a serious movement in the reverse direction, with a net decline in standard brands compared with a week ago of roughly £2 a ton. A fair amount of buying interest has been shown in both spelter and lead, but both these metals have been influenced to some extent by the fall in copper, and declines of 7s. 6d. and 5s. a ton respectively have occurred. In each case, however, quotations are very much higher than they were at mid-June.

Iron and Steel.

A rather sudden disposition on the part of Lancashire pig iron users to regard present prices as presenting a favourable buying opportunity has resulted in a departure from the hand-to-mouth policy which they have rigidly adhered to for so long a time. For several months, forward buying of any consequence was virtually unknown. The result has been a steady dwindling of stocks in the hands of consumers, and in many instances during the past week or so a freer demand has been experienced on the Lancashire markets, with buyers, in some cases, venturing several months ahead. If the movement has not been dictated by an actual increase in foundry activity, it indicates a healthy return of confidence, and there is some hope that it may lead to a gradual improvement in foundry trade order books. In the meantime, pig iron prices are steady at 77s. per ton for Derbyshire, Staffordshire, and Cleveland makes of No. 3, 65s. 6d. for Northamptonshire, about 87s. 6d. for Scottish, and 81s. for West Coast hematite—all for delivery equal to Manchester. Bar iron sales continue on quiet lines, but prices keep up at £9 15s. per ton for Lancashire Crown quality material, and £8 5s. for second quality. Unsatisfactory conditions still obtain in the majority of the heavy steel-using industries in this part of the country, and the slow state of the steel market here is accentuated by the fact that there is a disposition among users to regard price cuts as a not remote contingency. Certainly there is not the feeling of confidence that has developed in the foundry iron section, and most rollers express disappointment, both with the number of orders and the weight of material involved. Small re-rolled bars are quoted here at about £6 10s. per ton, acid and basic boiler plates at £9, joists at £8 15s., sections at £8 7s. 6d., large bars at £9 7s. 6d., and tank plates at £8 17s. 6d. The market for imported steel materials retains its newly acquired firmness, but orders of any consequence are few and far between so far as this market is concerned.

BARROW-IN-FURNESS.

Hematite.

At the present time there does not seem to be a bright spot in the hematite pig iron market. Buyers are

only taking small deliveries as a general rule, and there is little or no tendency to order forward. The change for the better is still to come. With restrictions of output, stocks are not on the whole increasing, but the present production is low. The furnaces at Barrow are still temporarily damped down. American business up to now has been thin, and trade with the Continent has been quiet, but there were shipments to Hamburg last week, and cargoes went coastwide to London and Wales. The iron ore trade is naturally quiet, both as regards native sorts and foreign. The steel market is also very dull, and fresh orders are required to start the rail mills again. The hoop and small sections mills have orders which keep them going. Fuel is in quiet demand.

Shipbuilding.

The Orient liner "Otranto," which was launched by Vickers-Armstrongs six years ago, has come back to the builders for a complete overhaul. During her stay in Barrow superheaters will be introduced. The P. and O. liner "Strathaird" will be launched by the Countess of Inchcape at two o'clock on Saturday, July 18th. The fitting-out docks will then present an imposing sight, with the "Otranto" in the Devonshire Dock and the "Strathnairn" and the "Strathaird" in the Buccleuch Dock.

SHEFFIELD.

(From our own Correspondent.)

Hopes Deferred.

THE expected revival of trade, consequent on the movement to suspend war interest payments and reparations, is unlikely to take place for some time. So far from creating a feeling of confidence, the new attitude of the Powers has, if anything, caused a certain amount of unsettlement and checked developments which might bring work to the metal departments. Until the reparations holiday becomes an accomplished fact, or is within measurable distance of that condition, there is not much likelihood of trade recovering anything approaching its former prosperous state. Therefore the eagerly awaited revival is deferred.

Sheffield and the Boxer Fund.

There has been much speculation concerning to what extent Sheffield and district will benefit by the expenditure of the Boxer Fund. One thing is clear, namely, that the city can meet all requirements, but it now appears that it is not likely to gain any very substantial advantage. Tenders for railway work in connection with the distribution are now being considered, but price will be the determining factor in awarding the contracts. Competition for the work is very keen. The contracts include those for seven or eight locomotives, a number of carriages, and nearly 10,000 tons of steel sleepers. Rationalised firms here could execute all these orders with profit, but they are not expected to get more than a tithe of the work. At the same time Sheffield should obtain some good subcontracts for castings, forgings, tires, axles, and springs.

Stainless and Special Steels.

After a period of comparative quietude, the demand for stainless steel is improving, and no industry is more indebted to this invention than that of the manufacture of chemicals. The discovery of corrosion-resisting metals and their use for vessels and receptacles in chemical making has been of inestimable value in saving equipment from rapid destruction by the action of acids. It is not surprising, therefore, that the largest users of stainless steel are the chemical firms, one of which was recently supplied with 1000 tons. At the present time, stainless steel is the only really live branch of the steel trade, and in the past it has brought a great volume of work and money to Sheffield. Makers of all kinds of special steels, on the other hand, complain of extreme scarcity of orders, and although they are meeting the competition of foreign chrome-nickel constructional steels, there are no reports of improved trade. It is pleasing, however, to know that they have so reduced their costs that British users obtain no special advantage by buying foreign steel.

A Result of Rationalisation.

It is now possible to give some idea of the effect of the amalgamation, carried out nearly a year ago between the two well-known Sheffield firms of John Brown and Co., Ltd., and Thos. Firth and Sons, Ltd. The promoters claim that a measure of true rationalisation has been carried out under the most favourable conditions. Substantial economies have been effected already without any loss of efficiency, and the full benefit of these economies will be felt when a revival of trade takes place.

Sand Spun Pipes.

I have referred previously to the Staveley Coal and Iron Company's project for the manufacture at its Staveley works of sand spun cast iron pipes by centrifugal casting in dried sand moulds, rammed in metal flasks, and revolving at high speed until solidified. The plant is now in operation and the company has commenced production under exclusive licence from the Sand Spun Corporation of America. As a preliminary, one shift daily is being worked. The plant embodies the most modern principles, and is capable on a three-shift system of turning out straight pipes by this process at the rate of one every minute and a-half. The present sizes being manufactured range from 4in. to 12in. diameter, but provision has been made for future extensions. Among the advantages claimed are that the new pipe, being made in 16ft. lengths, and containing roughly the same amount of iron as the ordinary standard 12in. pipe—of which the Staveley company also produces a matter of 100,000 tons annually—is laid with a reduced number of joints, thus effecting a saving in labour, handling, and transport. By reason of the centrifugal action it combines increased toughness, elasticity, and resistance to shocks, and is free from impurities. The pipe has a larger bore, perfect smoothness, and is uniform in section. The whole of the materials used are British; the ore comes from the company's own mines, and is smelted at the adjoining Devonshire Works; while the coke used is made from coal raised at adjacent collieries, also owned by the company. In appearance, the socket of the sand spun pipe differs from that of the standard vertically cast pipe, being specially designed to produce an even flow of metal consistent with added strength. The inside of the socket, however, conforms to standard dimensions, and the pipe can be used with British Standard "specials," as well as with existing cast iron pipes. The plant is accommodated in a building which has been designed, constructed, and erected by Markham and Co., Ltd., Chesterfield—a subsidiary company of the Staveley concern—and the same firm has supplied the greater part of the requisite machinery. The main structure is about 72ft. high, 420ft. long, and 200ft. wide.

Safety Razors and Blades.

The vogue of the safety razor has brought a new industry to Sheffield since the war and a number of firms are turning out huge quantities of blades and marketing them successfully against severe continental competition. One Sheffield firm, which has installed new plant in order to cope with increasing orders, will introduce shortly a new blade that is likely to appeal to the market, as well as a new and light razor holder in rustless steel.

Urban Schemes.

A scheme of the Mablethorpe and Sutton Urban District Council to spend about £55,000 on a new sewage scheme has been sanctioned. Originally the estimate was £67,306, but sanction to the proposal is subject to certain technical modifications, by means of which a reduction of some £12,000 has been possible. The same authority has also received permission for a public water supply scheme, involving an expenditure of £26,540, and work in connection with this and the sewage scheme will be put in hand almost at once. Scarborough Town Council is to apply for a grant towards the cost of resewering, which is estimated to be £27,850. The provision of a new pumping station, plant, and other works of sewerage and sewage disposal is estimated to cost the Castleford Urban Council £28,180, towards which a grant is expected.

Humber Bridge Opposition.

Despite a hint from the Minister of Transport that the Unemployment Grants Committee may make a grant towards the erection of training walls for the protection of the navigation of the Humber, it is expected that the Humber Conservancy Board and the Goole and the Leeds Chambers of Commerce will carry their opposition to the Humber Bridge Bill to the House of Lords. Before the Bill was read a third time in the House of Commons without a division, Members of Parliament representing Pontefract and the Don Valley withdrew an amendment which sought to provide that the bridge shall not be commenced until a local Act has been passed authorising the construction of suitable training walls and requiring them to be constructed simultaneously with the construction of the bridge. The main object of the Leeds Chamber of Commerce in opposing the Bill is to keep open the water route *viâ* the Humber, Ouse, and Goole to Leeds and the West Riding, thus maintaining that alternative route to the sea which has been such a great advantage to Leeds imports and exports. It is estimated that the loss of Goole as a port for Leeds and the areas north and south of the river between those points would mean a loss to Leeds traders of £25,000. Excluding coal shipments, it is estimated that there will be a loss of £50,000 a year to the railway companies on general goods at present handled to and from Goole. The Aire and Calder Navigation possesses over 1000 40-ton compartment boats for conveying coal from the pits to Goole, which can only be used inside locked water. They cannot be used on the Humber, and will therefore be so much scrap if coal has to be sent to Hull for shipment instead of Goole.

NORTH OF ENGLAND.

(From our own Correspondent.)

Iron and Steel Trade Outlook.

CONTINUED inactivity in the iron and steel market and the absence of indication of early change for the better are causing uneasiness, as substantial buying is essential to enable producers to avoid laying more plant idle. Consumers expect values to fall, and are disinclined to place orders for more material than will cover current needs. Manufacturers are, however, still of opinion that price concessions would not be speedily followed by increase of buying. Probably, they would lower rates to some extent if they had reason to believe that such action would result in business of moment. The statistical situation is becoming disturbing. Stocks continue to increase. During the past four months there has been singularly little variation in the volume of iron and steel exports from the Cleveland district, the total for each month being in the neighbourhood of 50,000 tons. During June the tonnage shipped was 51,176, which compares with 48,148 tons in May; but there has been an ominous contraction in the volume of overseas trade of late, and there are grave fears as to whether it will be possible much longer to maintain the present limited output. Of 88 blast-furnaces on the North-East Coast only 22 are now operating, and unless contracts on the books are speedily augmented, it is feared that one or two will have to be blown out. It is significant that during the month of June only 3601 tons of pig iron were shipped from the Cleveland district from the Tees to foreign destinations, whereas the imports by rail and sea exceeded that tonnage. Shipments of pig iron to Scotland for the month totalled 3632 tons, Italy 1320 tons and Denmark 1000 tons. The finished iron and steel exports for the month totalled 39,138 tons, which compares with 36,332 tons in May. Approximately half the shipments of finished material went to London, whilst only 17,665 tons went to foreign destinations. Of this latter quantity 8866 tons were shipped to South and East African ports, 3560 tons to India, 2260 tons to Canada.

Cleveland Iron Trade.

Although there is not any material expansion in the volume of business in the Cleveland pig iron trade, the circulation of additional inquiries points to improvement in the near future. A disturbing factor is the continued arrival of Midland iron in the North-East district. Largely shut out from the Cleveland trade, merchants are dealing fairly extensively in Midlands iron, which is being delivered in the district at prices well below the local quotations. The latter, however, are maintained unchanged, No. 1 Cleveland foundry iron being 61s., No. 3 G.M.B. 58s. 6d., No. 4 foundry 57s. 6d., and No. 4 forge 57s.

Hematite Pig Iron.

Conditions show little change in the East Coast hematite pig iron trade. Producers have no fixed prices, and terms of sale vary somewhat. Values are still falling, but manufacturers are slow to follow the downward movement, and a feeling prevails that quotations are approaching bottom. Hematite is cheap compared with rates named for other kinds of iron. Mixed numbers are offered at 62s. 6d., and No. 1 quality is on sale at 63s.

Iron-making Materials.

There is nothing being done in foreign ore, and renewal of buying cannot be expected until stocks have been reduced and consumers have accepted fair proportions of ore against old contracts. Nominally, best Rubio remains at 15s. c.i.f. Tees. Blast-furnace coke is plentiful, and good medium qualities are readily obtained at 15s. for early delivery to works in this area.

Manufactured Iron and Steel.

Orders coming forward in the manufactured iron and steel trade fall far short of what could be desired. In constructional steel sections tonnage output is fairly large and the departments engaged in the production of railway material have contracts to complete, but branches manufacturing shipbuilding requisites are greatly in need of orders, as are also certain other departments. Prices are due for revision, and it is expected that some reductions will be made. In the meantime, buyers are holding off the market.

Ironworkers' Wages.

Under the ascertainment issued this week by the Ironmasters' Association, the wages of blast-furnacemen, employed at North-East ironworks, have been reduced by 1·25 per cent. for the current quarter. This brings the men's wages down to 1 per cent. above the standard. According to the accountant's certificate, the average net selling price of No. 3 Cleveland pig iron for the three months ended June 30th was 55s. 1·93d., as compared with 56s. 3·37d. for the previous quarter.

Coal Mines Bill.

If the supplementary Coal Mines Bill is passed in its present form, it will affect Northumberland and Durham less than other districts, which have been agitating for the spread-over of working hours. In the two Northern counties, there has been no spread-over since the 7½ hours began to operate last December, and, so far as can be ascertained, the output has not gone down as a result of the alteration from 8 hours to 7½ hours. A 7-hour day might, of course, make a serious change in the economic position. With wages stabilised and the 7½-hour day to continue for the next twelve months, Northumberland and Durham will be no worse off than they have been in the past seven months. The coal exporters fear that the Government, through the Mines Department, may curtail their present functions. It has been said that the Minister of Mines is not unfavourable to them, but does not like the speculative side of exporting. Until minimum prices came in, exporters, of course, took big risks by buying large quantities of coal and then sought customers for it. Exporters in this district have met and discussed the situation, and have resolved to resist to the utmost any attempt to interfere with their individual liberty in the export of coal.

The Coal Trade.

The Northern coal market is a little more animated than recently, but the movement is not sufficient to have any hardening effect upon coal prices. The collieries of Northumberland and Durham are operating at low quotas, as is usual at the beginning of a new quarter, but they appear to be equal to present requirements, which are limited at this season. The disposal of small coals is a problem that reflects the quiet state of industry. Two small orders have been secured this week. The Bergen Gasworks has accepted offers of 30,000 tons of Horden, or similar class gas coal, to be shipped during August to March, but the price has not been disclosed, while merchants have received an order from the Genoa Gasworks for 30,000 tons of best Durham gas coal at 20s. 9d. a ton c.i.f. for shipment July to September. Generally, gas coal is moving quietly, and recent prices are maintained. Coking coals are not doing much at present, and the best line in bunkers is in the higher qualities, which are being readily disposed of. Best Durham unscreened bunkers are on offer at 13s. 6d. to 13s. 9d., with seconds a very quiet trade at 13s. to 13s. 3d. New business for Northumberland steam coals circulates slowly. The position is no worse than of late, however. Best Northumberland steam coals are quoted at 13s. 6d. and seconds at 12s. Ordinary patent foundry coke is one of the improving features of the fuel market of the market at the moment. The old quotation of 14s. 6d. seems to have been superseded by a more or less steady 15s. Forward, the price has become stronger at up to 16s. The inquiries are fairly widespread, and makers are hoping to reduce their stocks at an early date. Gas coke is being

offered freely, and although there are a few more inquiries, prices are easy, 18s. being asked for best kinds.

Shipbuilding Orders.

The first order booked at Sunderland for some months has been secured by Swan, Hunter and Wigham Richardson, Ltd., for a moderate-sized steamer. William Gray and Co., Ltd., have also booked an order for a 9000-tons vessel for Sir Robert Ropner and Co., Ltd., West Hartlepool. The vessel is for the coal and ore trade in and about the St. Lawrence River.

SCOTLAND.

(From our own Correspondent.)

Shipbuilding : Timely Order.

WITH the launching of the oil tanker "Conch," the Govan establishment of Harland and Wolff, Ltd., was added to the number of yards left without a ship on the stocks. At the week-end, however, it was announced that the firm had received an order from the Wallasey Council for the construction of a ferry steamer at a cost of £43,290. The new boat will have a gross tonnage of 350, and accommodation for 2500 passengers.

Holiday Influences.

Home markets are now being affected to some extent by the holiday season. Some districts are already on vacation, and others will follow suit throughout the month of July and part of August. Prospects are not particularly bright, although in some quarters a more hopeful view has been encouraged by the American debt proposals.

Steel.

Conditions in the steel trade are still most unsatisfactory. Commitments are wholly inadequate, and steel works require specifications for all materials, especially plates and sections. The market for sheets is depressed, consumers buying in very small quantities, while continental competition is very keen in all directions. Prices are unchanged, but lower values are said to have been accepted. A shade more interest has been shown in galvanised sheets for shipment, but inquiries from Australia and India are slow to expand.

Tubes.

Employment in the tube trade is not improving, the majority of the works still operating on alternate weeks only. It is worthy of note that makers of butt-welded tubes have been offered continental tube strip at the very low price of £4 7s. 6d. per ton, delivered Glasgow.

Iron.

In neither the home nor export trade is there any improvement in the iron market. Steel re-rollers experience keen competition, and the business being done is extremely modest, despite cheaper prices. Bar iron is unchanged and re-rolled steel is quoted £6 5s. home and £6 2s. 6d. per ton export.

Pig Iron.

Depression among consumers and imports of iron from India and the Continent make business extremely difficult for the local producer. Only six furnaces are in blast, but supplies are ample.

Scrap.

The demand for scrap is most restricted, and prices remain round about 49s. 3d. for cast iron machinery and 37s. 6d. per ton heavy steel.

Coal.

The possibility of a stoppage in the Scottish coal trade has had little effect on the market, so far as business is concerned. There has perhaps been a little more done on home account, but nothing like what might have been expected in anticipation of a stoppage. Importers abroad have revealed no inclination to augment their commitments, and shippers continue to experience considerable difficulty in securing business in competition with Polish fuel. Large fuels, apart from best Fifeshire sorts, which are firmly held, are in good supply for immediate shipment, and prices are inclined to weakness, but may, of course, be quickly affected by future action in the industry. Washed materials as a rule are only in moderate supply, and are firmly held. Aggregate shipments amounted to 237,273 tons, against 246,293 tons in the preceding week, and 244,986 tons in the same week last year. In this year to date aggregate shipments show a drop of 1,077,988 tons, compared with the same period last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

The Coal Trade.

SINCE I wrote a week ago nothing seems to have gone right for the steam coal trade of this district. The interview which the South Wales deputation had last week with the Admiralty relative to the reversion from oil to coal for the Navy was very disappointing, while the settlement of the hours and wages question for the coalfield contains features which are perturbing not only to leaders in the coal industry, but to all industries, and, furthermore, it is doubtful whether a week has ever been experienced when there was a more marked paucity of inquiry for coals. Yet there is the satisfaction that shipments from this district keep up well. According to the returns of the Great Western Railway Company, the total for last week came to 483,000 tons, which compared with 438,000 tons for the preceding week, while for the corresponding period of last year the total was 532,567 tons. At the end of last week the number of idle tipping appliances was thirty-five, and this week was begun with a total of twenty-nine idle appliances, which cannot be described as at all satisfactory. Now that the crisis in coalfield affairs is past, and that it is certain there will be no interruption of work, hopes are entertained that a better demand for coals from this area will be experienced, but that unfortunately cannot be relied upon. Business is going to competitors for the reason that their prices are lower, and credit facilities are offered by them which South Wales sellers cannot entertain in many cases. Reference has also been made to the threatened restriction by continental countries of imports of coal, and the anxiety which has been felt locally on that score, but so far as action on these lines by France is concerned, the latest news on this subject is not so alarming. Speaking at a meeting of the Cardiff Chamber of Commerce on Monday, Mr. C. L. Clay, who was one of the delegates to the French Coal Importers' Congress, stated that the question of import restrictions was discussed at the Congress, and it was pointed out by the French importers that any such restrictions, if imposed, would be aimed not so much at Great Britain as Belgium and Holland. In another quarter it is reported that the proposed new Bill introduced into the French Parliament contemplates reducing the imports of German and British coals by 5 per cent., Belgian coals by 25 per cent., Polish coal by 30 per cent., Russian coal by 33 per cent., and Dutch coal by 50 per cent., as compared with 1930 figures. If this is the case, then imports of coal from this country will not be further affected, as exports of British coals to France are now so reduced as compared with last year that the 5 per cent. is far exceeded. So far as contract operations are concerned, no news has yet come to hand of the definite placing of the Egyptian State Railway's order for locomotive coals. The only new inquiries on the market are in respect of the Swedish Naval Administration's request for prices for 20,000 tons of best Admiralty large coals for delivery from August to October, and prices have also been asked for 25,000 tons of patent fuel for the Peleponnesus Railway, to be delivered from September to April next.

Coal versus Oil for the Navy.

As a matter of record, reference should be made to the interview which the South Wales deputation had last week with the Admiralty concerning the utilisation of coal instead of oil by the Navy. The deputation was disappointed that it was not received by the First Lord of the Admiralty, Mr. A. V. Alexander, but by Mr. Charles G. Ammon, Parliamentary and Financial Secretary to the Admiralty, members of the Board of the Admiralty, and several heads of the engineering and design departments of the Board. Members of the deputation put forward their arguments in favour of coal in a discussion lasting two hours, and the petition prepared with so much care was laid before the Admiralty, but the Board's reply was not favourable. Its case was presented under four heads: operational, technical, manning, and supply. The Admiralty representatives, it is understood, intimated that they would be willing to receive further representations after the South Wales interests had considered the Board's reply. One great mistake apparently which the deputation made was that it did not take its experts with it to the interview, but the matter is not to be allowed to drop. The movement for reverting to coal is to be gone into more than ever with a view to further representations.

Hours and Wages in Coal Mines.

Now that the crisis is past, there is very little to be said for the moment, except that neither the employing interests, the exporting interests, nor the miners are satisfied with the legilsation which has been adopted to bring about the settlement. It is, in fact, no settlement, as from the point of view of trade there is the constant feeling of insecurity to be faced, which is inimical to the arrangement of contracts ahead, while the fact that wages are stabilised by enactment is a precedent which leaders in all branches of inudstry view with no little alarm. As regards the miners, the delegates at the South Wales miners' conference on Monday decided to refer the leaders' recommendation to accept the terms embodied in the Government Bill to the lodges. There was a small majority in favour of this course, though a large number of delegates intimated that they had voted for a reference to the lodges because, while they were personally favourable to acceptance, they felt they could not take responsibility for voting in favour of acceptance before they had had another opportunity of conferring with the men at lodge meetings.

Portuguese Government Bombshell.

Considerable excitement was in evidence on the Cardiff Coal Exchange on Wednesday, when news came through that the Portuguese Government had abolished the Gold Decree in respect of cargo and lighthouse dues and had increased port dues, thus imposing upon shipowners an additional charge of about 7d. per ton, except in the case of vessels belonging to those countries which are on an approved list and which have the benefit of a reduction of 25 per cent. The action of the Portuguese Government came as a great surprise, more particularly in view of the fact that the new Maritime Act operates retrospectively from July 1st. Representations are being made that adequate notice of three or six months should have been given to the trade in view of the complications that will arise in the case of steamers already chartered for loading cargoes of coal to Portuguese ports.

Tonnage Laid Up.

Returns issued by the Great Western Railway Company of tonnage laid up at South Wales ports show that on July 1st the number of vessels was sixty-eight of 148,735 tons net register, which compares with seventy-nine vessels of 157,160 tons net on April 1st last. Of the total of sixty-eight vessels out of commission, all but one are British owned, the one foreign-owned vessel at Barry being a small vessel of 395 tons.

Road Scheme Defeated.

Some time ago reference was made to the proposal for the construction of a new by-pass road from Briton Ferry to Lonlas, Skewen, with a bridge over the river Neath at Briton Ferry, estimated to cost three-quarters of a million pounds. This scheme has now been turned down by the Neath Town Council, it being stated that the repayment of capital and interest would work out at £600 a week, and the benefit would only be a matter of eight minutes gained by motorists using the road.

Tin-plate and Coal Items.

Four additional mills were restarted on Monday at the Duffryn Tin-plate Works, Morriston, where about a week ago six of the fourteen mills resumed after several months' idleness. The finishing department is expected to start operations soon. At the Kidwelly Tin-plate Works, six mills were restarted on Tuesday, the millmen to work alternate shifts of six and eight hours. These works have been idle for twelve months. Notices have also been posted up at the Whitford Steel Sheet Galvanising Works, Briton Ferry, that the mills will be restarted on Monday, the 13th inst. These works belong to the Grovesend group. This resumption means employment for about 250 men. Some of the tin-plate works in this district have received quite a number of new orders lately. The possibility of prices increasing is given as the reason for orders coming on the market which have been held back. This week has seen a resumption of work at the Bedwas Colliery, which, on account of a dispute, has been idle for a long time.

Current Business.

The steam coal market has been devoid of any life. It is questionable whether the conditions have ever been more unsatisfactory from the point of view of the dearth of orders for prompt shipment. Quite a number of firms have no orders at all, and even the biggest undertakings have not had a smaller list of orders for which tonnage is required than is the case at the moment. In the circumstances, prices are at the minima. Large coals are certainly better placed than smalls, which continue to be banked owing to there being a lack of outlet for them. Patent fuel has met with a slightly better inquiry, but nothing like what is required to make this industry active. Coke is quiet and pitwood, owing to the moderate demand, is about 21s. to 21s. 6d.

CATALOGUES.

JUDD, BUDD, Ltd., Oxford House, John-street, E.C. 3.—"Efficiency Without Smoke."

G. A. HARVEY AND CO. (LONDON), Ltd., Woolwich-road, S.E. 7.—A booklet on "Galvanising v. Rust."

BRISTOL AEROPLANE COMPANY, Ltd., Filton House, Bristol.—A brochure on the construction of steel aircraft.

PULSOMETER ENGINEERING COMPANY, Ltd., Nine Elms Ironworks, Reading.—List No. 0618 of turbine centrifugal pumps.

FLEXIBLE DRIVE AND TOOL COMPANY, 3, Bloomsbury-place, W.C. 1.—Catalogue of Biax flexible shafts and tools and their uses.

J. STONE AND CO., Ltd., Deptford, S.E. 14.—Pamphlet No. 11, describing in detail the "Stone" system for hydraulically controlling bulkhead doors.

W. T. HENLEY'S TELEGRAPH WORKS COMPANY, Ltd., Holborn-viaduct, E.C. 1.—Sixth edition of catalogue W.A.I. on distribution pillars and panels.

BRUCE PEEBLES AND CO., Ltd., Edinburgh.—Pamphlet No. 25, dealing with small and medium squirrel-cage and slip-ring induction motors of standard types.

GLASGOW ELECTRICAL ENGINEERING COMPANY, Ltd., 45–47, Pitt-street, Glasgow.—Publication 2531 on "Garty-Apex" wind motors (wind dynamos or windmills).

G. AND J. WEIR, Ltd., Cathcart, Glasgow.—Revised edition of section 3 catalogue of marine evaporators, distilling plants, &c.; and publication 33 on regenerative condensers.

HERBERT MORRIS, Ltd., Loughborough.—A bound catalogue of 437 pages illustrating and describing conveyors for the transfer of all kinds of basic materials, units of production, or finished manufactures.

CASSEL CYANIDE COMPANY, Ltd., Oldbury, near Birmingham.—"The Heat Treatment of Steel in Molten Salts"; "The Casehardening and Heat Treatment of Steel by Sodium Cyanide"; "The Cassel Cyanide Case-hardening Furnace."

CONSOLIDATED PNEUMATIC TOOL CO., Ltd., 170, Piccadilly W. 1.—The following catalogues: S.P. 156, "CP One-shot Riveting Hammer"; S.P. 157, "CP–100 and 101 Vibrators"; S.P. 158, "CP–66 Rotary Surfacer"; S.P. 159, "Mobility"; S.P. 160, "Rivet Snaps"; S.P. 161, "Quimby Pump."

LENNOX FOUNDRY COMPANY, Ltd., Glenville-grove, S.E. 8.—Catalogue 4, "Rotary Vacuum and Pressure Pumps and Positive Blowers"; Catalogue 5, "Standard Valves, Pipes and Fittings in Acid Resisting Metals"; Catalogue 6, "Standard Basins, Vessels, Pans and Plant in Acid Resisting Metals"; Catalogue 7, "Centrifugal in Tantiron and other Corrosion Resisting Metals."

HIGH-PRESSURE FORGINGS.—We have received from the English Steel Corporation, Ltd., Vickers Works, Sheffield, a photograph taken in the works showing three forgings, two of which weigh 42 tons each, whilst the other weighs 23 tons. They form a consignment to complete an order for 500 tons of such forgings which the firm has just supplied for use in Canada. They are forged drums of high tensile alloy steel for use in chemical work under conditions of very high pressure and temperature, and are virtually gun barrels flanged at the ends and closed by covers bolted on.

ROYAL AIR FORCE.—The Air Ministry announces that about five vacancies for permanent commissions in the Stores Branch of the Royal Air Force will be offered for competition among young men of between twenty-three and twenty-five years of age on January 1st, 1932, who have had not less than five years' business experience in a firm of standing. This will be the sixth competition under the scheme inaugurated in 1926 for the purpose of obtaining men with a business training to control and administer the supply of the highly valuable and complex equipment of the Royal Air Force. Application should be made to the Secretary, Air Ministry (S. 7), Kingsway, London, W.C. 2, for the regulations and for application forms. Completed application forms should reach the Air Ministry by August 15th next, or at the latest by September 1st.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
(1) Native	16/- to 20/6
(1) Spanish	16/-
N.E. COAST—	
Native	18/- to 21/-
Foreign (c.i.f.)	15/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(3) SCOTLAND—		
Hematite	3 10 0	—
No. 1 Foundry	3 13 6	—
No. 3 Foundry	3 11 0	—
N.E. COAST—		
Hematite Mixed Nos.	3 2 0	3 2 0
No. 1	3 2 6	3 2 6
Cleveland—		
No. 1	3 1 0	3 1 0
Siliceous Iron	3 1 0	3 1 0
No. 3 G.M.B.	2 18 6	2 18 6
No. 4 Foundry	2 17 6	2 17 6
No. 4 Forge	2 17 0	2 17 0
Mottled	2 16 6	2 16 6
White	2 16 6	2 16 6
MIDLANDS—		
(e) Staffs.—	(*Delivered to Station.*)	
All-mine (Cold Blast)	—	—
North Staffs. Forge	3 1 0	—
„ „ Foundry	3 6 0	—
(e) Northampton—		
Foundry No. 3	3 2 6	—
Forge	2 17 6	—
(e) Derbyshire—		
No. 3 Foundry	3 6 0	—
Forge	3 1 0	—
(3) Lincolnshire—		
No. 3 Foundry	—	—
No. 4 Forge	—	—
Basic	—	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	3 19 6 (a) / 4 1 6 (b) / 4 6 6 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	10 5 0	9 15 0
Best	—	—
N.E. COAST—		
Iron Rivets	11 5 0	—
Common Bars	10 10 0	—
Best Bars	11 0 0	—
Double Best Bars	11 10 0	—
Treble Best Bars	12 0 0	—
LANCS.—		
Crown Bars	9 15 0	—
Second Quality Bars	8 5 0	—
Hoops	12 0 0	—
S. YORKS.—		
Crown Bars	10 0 0	—
Best Bars	10 15 0	—
Hoops	12 0 0	—
MIDLANDS—		
Crown Bars	9 5 0 to 10 7 6	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	8 10 0 to 9 0 0	—
Gas Tube Strip	10 12 6	—

STEEL. (*d*)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates (Marine)	10 10 0	10 10 0
„ „ (Land)	10 10 0	10 0 0
Ship Plates, ½in. and up	8 15 0	7 15 0
Sections	8 7 6	7 7 6
Steel Sheets, ¼in.	7 10 0 to 7 15 0	8 0 0
Sheets (Gal. Cor. 24 B.G.)	11 7 6 10 0 0 to 10 5 0	

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 15 0	7 15 0
Angles	8 7 6	7 7 6
Boiler Plates (Marine)	10 10 0	—
„ „ (Land)	10 0 0	—
Joists	8 15 0	7 7 6
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5s.
Hard Billets	8 2 6	—
Soft Billets	6 17 6	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	—
Billets	6 10 0 to 9 0 0	—
MANCHESTER—		
Bars (Round)	9 7 6	—
„ (Small Round)	6 10 0	—
Hoops (Baling)	10 0 0	9 15 0
„ (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
„ (Lancs. Boiler)	9 0 0	—
SHEFFIELD—		
Siemens Acid Billets	9 2 6 (basis)	—
Hard Basic	8 2 6 and 8 12 6	—
Intermediate Basic	6 12 6 and 7 2 6	—
Soft Basic	6 0 0	—
Hoops	9 10 0 to 9 15 0	—
Soft Wire Rods	7 15 0	—
MIDLANDS—		
Small Rolled Bars	6 7 6 to 7 0 0	—
Billets and Sheet Bars	5 0 0 to 5 15 0	—
Galv. Sheets, f.o.b. L'pool	9 17 6 to 10 5 0	—
(2) Staffordshire Hoops	9 10 0	—
(*d*) Angles	8 7 6	—
(*d*) Joists	8 15 0	—
(*d*) Tees	9 7 6	—
(*d*) Bridge and Tank Plates	8 17 6	—
Boiler Plates	9 0 0	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14 f.o.b.	13/6 to 13/9
Block Tin (cash)	117 12 6
„ (three months)	119 10 0
Copper (cash)	36 10 0
„ (three months)	37 2 6
Spanish Lead (cash)	13 7 6
„ „ (three months)	13 15 0
Spelter (cash)	12 16 3
„ (three months)	13 7 6
MANCHESTER—	
Copper, Best Selected Ingots	39 0 0
„ Electrolytic	40 10 0
„ Strong Sheets	70 0 0
„ Tubes (Basis Price), lb.	0 0 10½
Brass Tubes (Basis Price), lb.	0 0 9½
„ Condenser, lb.	0 0 11½
Lead, English	14 7 6
„ Foreign	13 5 0
Spelter	13 0 0
Aluminium (per ton—raw ingot)	£85

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/11½ per lb.	
Ferro Tungsten	1/8½ per lb	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£21 0 0	7/-
„ „ 6 p.c. to 8 p.c.	£20 12 6	7/-
„ „ 8 p.c. to 10 p.c.	£19 17 6	7/-
„ „ Specially Refined		
„ „ Max. 2 p.c. carbon	£30 0 0	10/-
„ „ „ 1 p.c. carbon	£34 0 0	12/-
„ „ „ 0·70 p.c. carbon	£36 0 0	14/-
„ „ „ carbon free	9½d. per lb.	
Metallic Chromium	2/7 per lb.	
Ferro Manganese (per ton)	£11 0 0 for home	
„ „ „	£11 10 0 for export	
„ Silicon, 45 p.c. to 50 p.c.	£10 10 0 scale 5/- per unit	
„ „ 75 p.c.	£15 0 0 scale 7/- per unit	
„ Vanadium	12/9 per lb.	
„ Molybdenum	4/2 per lb.	
„ Titanium (carbon free)	9d. per lb.	
Nickel (per ton)	£170	
Ferro Cobalt	9/- per lb.	

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	13/6
„ „ Ell	14/-
„ „ Splint	14/6 to 16/-
„ „ Trebles	12/-
„ „ Doubles	11/6
„ „ Singles	10/6 to 10/9
AYRSHIRE—	
(f.o.b. Ports)—Steam	12/9
„ „ Jewel	17/-
„ „ Trebles	12/-
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	10/6 to 12/6
Screened Navigation	16/6 to 17/6
Trebles	12/- to 13/-
Doubles	11/6
Singles	10/9
LOTHIANS—	
(f.o.b. Leith)—Best Steam	11/-
Secondary Steam	10/6
Trebles	12/-
Doubles	12/-
Singles	10/6 to 10/9

ENGLAND.

	Export.
(8) N.W. COAST—	
Steams	20/-
Household	30/- to 51/-
Coke	20/- to 20/6
NORTHUMBERLAND—	
Best Steams	13/6
Second Steams	12/-
Steam Smalls	7/6 to 8/-
Unscreened	12/6 to 13/-
Household	27/- to 39/-
DURHAM—	
Best Gas	14/6
Second	13/3 to 13/6
Household	25/- to 37/-
Foundry Coke	24/-

SHEFFIELD—	Inland.	Export.
Best Hand-picked Branch	24/6 to 25/6	—
Derbyshire Best Bright House	19/- to 20/-	—
Best House Coal	18/6 to 20/-	—
Screened House Coal	17/- to 18/-	—
„ „ Nuts	14/6 to 15/-	—
Yorkshire Hards	15/- to 16/6	—
Derbyshire Hards	15/- to 16/6	—
Rough Slacks	8/6 to 9/6	—
Nutty Slacks	6/- to 7/6	—
Smalls	4/- to 5/6	—
Blast-furnace Coke (Inland)	12/3 on rail at ovens	
Furnace and Foundry Coke (Export), f.o.b. 14/- to 15/-		

(9) SOUTH WALES.

CARDIFF—	
Steam Coals :	
Best Smokeless Large	20/-
Second Smokeless Large	18/9 to 19/9
Best Dry Large	18/6 to 19/3
Ordinary Dry Large	17/9 to 18/-
Best Black Vein Large	18/3 to 18/9
Western Valley Large	18/- to 18/6
Best Eastern Valley Large	17/9 to 18/-
Ordinary Eastern Valley Large	17/9 to 18/-
Best Steam Smalls	13/6 to 14/-
Ordinary Smalls	11/- to 13/-
Washed Nuts	18/- to 21/-
No. 3 Rhondda Large	19/9 to 20/3
„ „ Smalls	15/- to 16/-
No. 2 „ Large	17/- to 17/3
„ „ Through	15/6 to 16/-
„ „ Smalls	14/- to 14/3
Foundry Coke (Export)	22/- to 36/6
Furnace Coke (Export)	16/6 to 17/6
Patent Fuel	20/- to 20/6
Pitwood (ex ship)	21/- to 21/6
SWANSEA—	
Anthracite Coals :	
Best Big Vein Large	35/- to 37/6
Seconds	27/- to 31/6
Red Vein	22/6 to 27/6
Machine-made Cobbles	41/6 to 45/-
Nuts	40/- to 46/-
Beans	24/9 to 28/3
Peas	21/- to 21/9
Breaker Duff	8/6 to 9/6
Rubbly Culm	8/6 to 9/6
Steam Coals :	
Large	20/- to 20/6
Seconds	18/- to 20/-
Smalls	11/6 to 13/-
Cargo Through	16/- to 17/6

(1) Delivered. (2) Net Makers' Works. (3) f.o.b. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield. (*c*) Delivered Birmingham. (*d*) Rebate : Joists (minimum), 22/6 ; Ordinary Ship, Bridge, and Tank Plates and Sections, 15/- if home consumers confine purchases from associated British Steel Makers. (*e*) Delivered Black Country Stations.

French Engineering Notes.

(From our own Correspondent in Paris.)

Compressed Coal Gas.

THE Congress on fuels for internal combustion engines at the International Colonial Exhibition completed its first session last week and is now being followed by a trial of vehicles running on all kinds of home fuels. The final reports dealt with compressed coal gas and suction gas. The use of coal gas for commercial vehicles is, of course, strongly recommended by the gas companies, which point to the convenience of this fuel in areas where there is an adequate distribution of gas. It is also of great importance for the colliery industry. The problems of deadweight and security are regarded by the French as being solved by means of cylinders of chrome-nickel steel, which, however, are not in extensive employment, and, as the weight of cylinders containing a sufficient supply to run a lorry a distance of 60 miles is about 550 kilos., it is obvious that the cost of the gas must be low in order to compete with petrol. The quantity of 1·7 cubic metres of gas of 4700 heat units per kilogramme is equivalent to 1 litre of petrol, and the cost of compressing it and other charges bring the total cost to a figure that is a little above or below that of petrol according to local conditions, and, of course, to the fluctuating price of the spirit. The economy of compressed gas, therefore, depends upon whether the gas companies can supply it at specially low rates for traction. There appears to be little doubt that methane gas from low-temperature carbonisation would provide a cheaper fuel of higher heat value, but so far as France is concerned the quality of the coal seems to leave little hope of the low-temperature carbonisation process being carried out on a sufficiently large scale to provide considerable quantities of methane gas. It is argued that in great industrial areas in proximity to coal mines compressed gas can be employed to advantage. So far as is observable at the moment, it can only be a supplementary fuel, and would be useful for heavy vehicles if gas or petrol could be employed economically in the engine at the same compression. This is the trouble with most national fuels, which would have a much better chance of successful application if a variable compression engine could be devised to run upon any of them indiscriminately. The use of compressed gas has not yet got beyond the stage of determining its economy. The Paris Omnibus Company has had two omnibuses running on gas in actual service for more than two years, and the Paris Gas Company employs this fuel on half-a-dozen lorries. On the omnibuses the gas is used in petrol engines at the ordinary compression, and on the lorries there is a wide range of compressions up to 7. The figures of fuel cost are interesting, but variable and not conclusive. The safe handling of compressed gas cylinders does not cause much concern to the French, who believe that the official test of 4978 lb. per square inch for a normal pressure of 2844 lb. per square inch offers a sufficiently large margin of security. Large users of compressed air cylinders know, however, that accidents will happen. Manufacturers of cylinders are not subjected to any rigid specification, and they are free to produce the strongest and lightest cylinders they can to withstand the official test. As with most national fuels, compressed gas is regarded as an emergency fuel and is being considered in the hope that it will help to exclude imported oils.

Torrefied Wood.

Another interesting report presented at the Congress was that prepared by Professor Dupont, of the University of Bordeaux, on his experiments with torrefied wood for gas producers. As already explained, the object of Professor Dupont is to utilise wood in such a way as to obtain a cleaner and more convenient fuel than charcoal and of a higher heat value, and at the same time to eliminate from the wood the water and carbonic acid and other by-products that are destructive to the pipes and detrimental to the engine. The process itself is simple and consists in subjecting the wood, cut small, to a temperature just below the point of carbonisation, whereby all the by-products are distilled, leaving a dense wood that will not easily absorb moisture. The idea is not a new one, but no attempt was made to work it out until the problem was taken in hand by Professor Dupont, who has proved that wood can be torrefied in an economical manner. Experiments are being continued in the direction of cheapening the process. This can readily be done in the case of fixed plants utilising waste heat, and it is hoped to evolve portable plants in which wood will be torrefied with the exhaust gases from internal combustion engines. Machines are being constructed for cutting wood to the required dimensions, the want of which has so far prevented the economical development of the process.

Compagnie Generale Transatlantique.

The Chamber of Deputies has authorised the Government to guarantee a loan of 160 million francs in order to refloat the Compagnie Générale Transatlantique. The State will also increase its subsidy to 80 million francs. Of the board of directors one-half will be selected by the State, one-quarter by the ports and Chambers of Commerce interested in the company's activities, and one-quarter by shipping interests. No member of the board will be allowed to have any interest in the subsidiary companies more or less dependent upon the C.G.T. Amongst the offers received by the Government was one from an American group to finance the company with 700 million francs.

Naval Construction.

Following upon the vote of the credits for the instalment of the naval construction programme to be put in hand during the present year, excluding the proposed battleship, the Minister of Marine has introduced to the Chamber of Deputies the instalment for 1932 and 1933. It comprises four second-class cruisers of about 7500 tons; a destroyer of from 2400 to 2600 tons; a torpedo boat; a river gunboat and a hydrographic survey steamer. The estimated expenditure is 1217 million francs.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

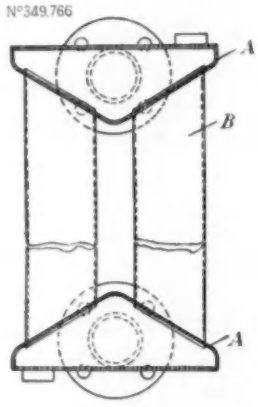
The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

TRANSFORMERS AND CONVERTERS.

349,766. May 22nd, 1930.—RADIATORS PARTICULARLY APPLICABLE TO THE COOLING OF OIL-IMMERSED ELECTRICAL TRANSFORMERS, The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C. 2, and Henry Stanley Holbrook, of 7, Rugby-road, Paddox Delivery, Rugby, and Joseph Mitchell Simpson, of 20, Cromwell-road, Rugby.

A well-known method of constructing detachable transformer radiators is to weld a series of tubes into top and bottom headers, but with this method there are usually small depressions surrounding the tubes where they enter the headers, and water is apt to collect in these depressions on the lower headers, thereby causing rusting around the ends of the tubes, thus shortening the

N°349.766



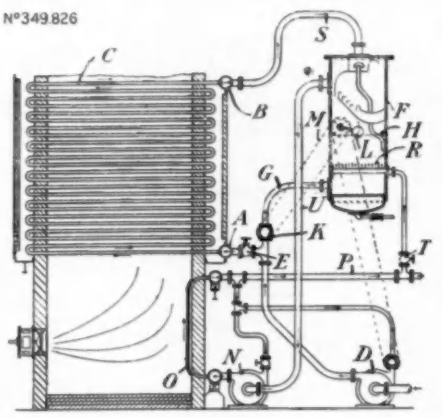
life of the radiators. The object of this invention is to overcome this objection and at the same time to provide a more efficient radiator by so constructing the headers that the cooling air rising adjacent the tubes has a freer passage than in the usual type of flat header. The headers A are formed of steel plates, and are of substantially triangular cross section, and the tubes B, which are shown oval in cross section, but may be of circular or other convenient shape, are inserted in the sloping sides of the headers. Thus, any water tending to collect around the junction between the end of a tube and the sloping wall of the lower header will run down the slope and drip off the radiator. The sloping sides of both upper and lower headers also allow free passage for the cooling air.—*June 4th*, 1931.

STEAM GENERATORS.

349,826. July 12th, 1930.—HIGH-PRESSURE BOILERS, *Babcock and Wilcox, Ltd., of Babcock House, Farringdon-street, London, E.C.* 4.

The improved high-pressure boiler described in this specification is shown fitted with a pulverised fuel burner. The inlet A and an outlet B are joined together by a continuous conduit C. Water is forced by a feed pump D to the inlet, a suitable valve E being provided to regulate the flow. At the outlet B a mixture of steam and water at high pressure is discharged, the feed pump maintaining sufficient pressure to prevent complete separation of steam and water in the generator, and this mixture is conducted to a separator F. Here separation takes place, and the water is collected in the bottom of the separator. If desired, the water line H may be maintained by means of a connection G from the feed pump, a valve K being provided in this connection

N°349.826



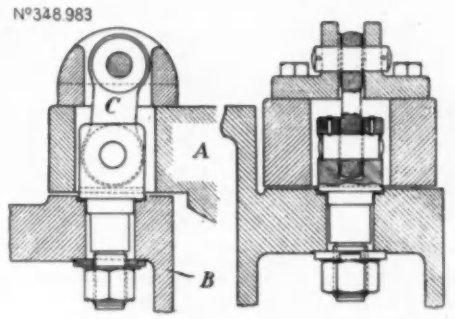
and controlled by means of a float L connected to the valve by a chain M. Steam from the separator passes through the pipe U to a pump N, which forces it through a superheater of the radiant heat type, placed at O. From the superheater the steam is led through the pipe P to an engine. A certain proportion of the superheater steam may be supplied to the turbines driving the pumps. A portion of the superheated steam is diverted from the main P into the water space of the separator and is there discharged as indicated at R. Owing to the additional pressure impressed upon it by the pump N, the superheated steam thus discharged is at a higher pressure than is the steam and water entering the separator through the pipe S, and this superheated steam gives up its superheat to evaporate some of the water in the separator, forming saturated steam, which mingles with that entering through the pipe S. By means of the valve T the flow of superheated steam to the separator may be regulated. By proper adjustment of the various parts described it is possible for the amount of steam supplied at R to the water in the separator to be so regulated as to evaporate the excess water introduced into the separator from the pipe S.—*June 4th*, 1931.

TURBINE MACHINERY.

348,983. September 9th, 1930.—SUPPORTS FOR STEAM AND GAS TURBINES, Aktiengesellschaft Brown, Boveri et Cie., Baden, Switzerland.

The general idea of this invention is that if the casing of a turbine working with very hot steam is supported on feet from the bed-plate, it will expand radially, and consequently rise with regard to the shaft, which is, of course, supported centrally.

N°348.983

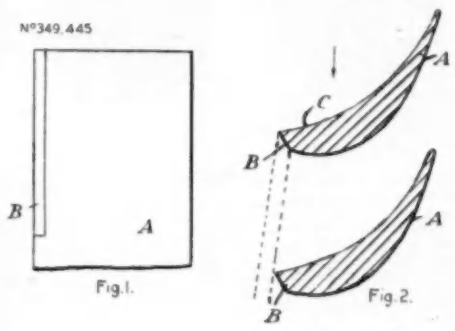


The result will be that the two become excentric. In order to meet this trouble, the inventors support the casing at the centre line by brackets. Such a bracket is shown at A, and is supported from the pedestal B by the link C, so that there is freedom for expansion. It is claimed that the means of connection reduce the transmission of heat to the pedestal to a minimum.—*May 21st*, 1931.

349,445. February 11th, 1930.—ELASTIC-FLUID TURBINES, The Honourable Sir Charles Algernon Parsons, Alfred Quintin Carnegie and Francis William Gardner, all of Heaton Works, Newcastle-on-Tyne.

Experience shows that in reaction steam turbines the rotor blades are eroded or corroded in the region of the tips at the low-pressure end of the turbine, and it is believed that this is due to impact of the blades with particles of water. The invention relates to a turbine in which the tip end of each blade or of some of the blades that suffer erosion is provided with one or more flat or substantially flat surfaces inclined to the line of impact. The blades A, A are so formed that, over the tip end liable to erosion, the curved face on the forward side of the leading or thick edge, that would receive the impact of the water particles in a direction substantially normal to its surface, is machined or otherwise treated so that it is replaced by a flat, B, or substantially flat surface lying at an angle to the relative direction

N°349.445



of impact of the blade and water particles. The flat surface thus formed lies across the end of the blade in the position indicated and is parallel to the length or axis of the blade. As only that part of each blade towards the tip suffers from erosion, the flat, B, extends for only a part of the length of the blade, as shown in Fig. 1. The flat may intersect the working surface C of the blade, so as to form an actual bevel, as shown in Fig. 2, or it may lie between curved portions of the back of the blade. By making the impingement oblique instead of substantially normal, the erosive effect of the impact of the blade and water particles is reduced or entirely avoided. It will be seen from Fig. 2 that the direction of impact of the blades and particles, shown by the dotted lines, is nearly circumferential, the axial velocity of the water particles being small in relation to the tip speeds of the blades; only a comparatively small area of each blade is thus left unshielded by its neighbour.—*May 11th*, 1931.

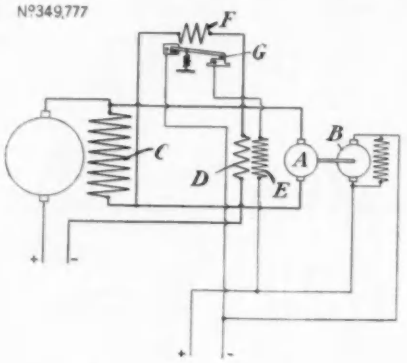
DYNAMOS AND MOTORS.

349,777. May 29th, 1930.—CONTROL OF ELECTRIC MOTORS, The Electro-Mechanical Brake Company, Ltd., of Eagle Works, West Bromwich, Stafford, and John Goad Smithson, of Oakdale, Alvechurch, Worcester.

The object of the invention is to provide improved means for controlling or regulating motors, whereby, in the case of tramway vehicles, more rapid acceleration can be obtained automatically over a large range of speed variation. The armature A of a small generator driven by an auxiliary motor B is connected to the ends of the series field winding C of the motor to be controlled or regulated. This generator A is provided with a pair of field windings D, E, one of which—D—is in series with the main motor field winding C, whilst the other—E—which is an opposing winding, is separately excited from any convenient source, for example, the same source as supplies current to the motor B. In series with the motor field winding C is a coil F forming the magnet winding of a trembler interrupter G, which controls the circuit of the opposing winding E in the generator. The armature of the motor to be regulated is indicated on the left. The generator A can act as a diverter, which provides an alternative path for the motor armature current in parallel with the motor field winding. When the motor is running slowly the current through the field winding C and, consequently, through the trembler winding F, is sufficient to hold the trembler contacts apart, and this condition persists until with increase of speed of the motor the current falls to some predetermined value. At this point the magnet of the trembler has become sufficiently weakened to allow the movable contact of the interrupter G,

under the action of a spring, to close on to the fixed contact and so close the circuit through the opposing winding E of the generator. With the closing of the trembler contacts the opposing field winding is brought into action, and the electromotive force produced by the generator falls, thereby allowing current to flow through the generator from the motor, and causing the current flowing through the motor armature to increase. The action of the trembler is to keep the armature current as

Nº349,777



nearly constant as possible, and by suitably designing the apparatus the armature current can be kept substantially constant over a large range of speed variation in the motor. In accordance with the invention, it is possible to maintain a practically uniform current in the motor armature. A constant torque can thus be obtained from the motor, and consequently more rapid acceleration of the vehicle is possible than is ordinarily obtainable, over a wide range of speed variation.—*June 4th*, 1931.

TELEGRAPHS AND TELEPHONES.

349,857. August 26th, 1930.—SUBMARINE COMMUNICATION CABLES, Siemens-Schuckertwerke Aktiengesellschaft, of Berlin-Siemensstadt, Germany.

According to this invention, the danger of fracture of the conductors of submarine communication cables is obviated by providing a tension member of high strength in the interior of the cable core. As a protection against very high water pressure, the lead sheath A—Fig. 1—is supported by a tubular metal sheath B. One of the usual armourings C is placed over the

Nº349,857

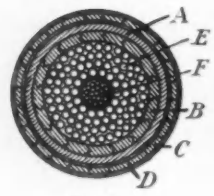


Fig 1.

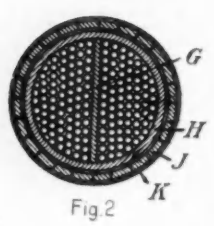


Fig.2

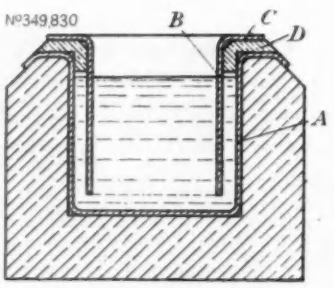
lead sheath. Layers of impregnated jute D are arranged above and below the armouring C, and stranded elements E are placed round the tension member F. In Fig. 2 the tension member consists of a twisted band G and the stranded elements are situated on both sides of the tension member. The tension member is designed so that it serves at the same time as supporting member for the lead sheath H. J is an armouring of flat wires, over which is arranged a winding K consisting of impregnated jute.—*June 4th*, 1931.

FURNACES.

349,830. July 19th, 1930.—FURNACE FOR THE HEAT-TREATMENT OF STEEL, Siemens-Schuckertwerke Aktiengesellschaft, of Berlin-Siemensstadt, Germany.

In electrode salt bath furnaces for the heat-treatment of steel, the containers for the reception of the salt consist of a tub or vat set in masonry, but these containers are not suitable for all salts. Cyanogen salts must not come into contact with chamotte or fire-clay, as the bath will at once begin to froth and become useless, whilst borax deteriorates the walls considerably. Consequently, when using these salts it is essential that metal pans should be used. Such furnaces are electrically heated, heating bodies being applied to the outside of the pan or crucible. The heat is transmitted through the crucible into the salt.

Nº349,830



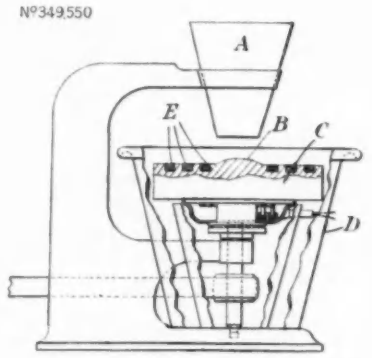
for which purpose a considerable head of heat is required, and there is a danger of burning through the heating element. According to the invention these and other drawbacks are obviated. The drawing shows a salt bath crucible furnace, which consists of furnace masonry work, in which a metal crucible A is arranged. In the metal crucible a cylinder B is suspended, and its outwardly curved flange C, with insulation D, is carried by the crucible. As in the cold state the salt is a bad conductor of current, the salt is liquefied by means of known starting electrodes or immersion resistance heating elements. After liquefaction of the salt bath the heating device is removed and the cylinder B with the crucible A is connected to the network. The heating of the salt then takes place inside the crucible as the current from the cylinder B serving as the second electrode flows through the salt to the crucible A. In order to secure a uniform high degree of heating of the salt bath, the cylinder B is preferably provided with perforations over its entire circumference.—*June 4th*, 1931.

MACHINE TOOLS AND SHOP APPLIANCES.

349,550. February 22nd, 1930.—ELECTRO-MAGNETIC SEPARATORS, Frederick William Windley, of "Corner House," Broomfield-road, Chelmsford, and Albert Ernest Windley, of "Lorraine," Upper Moulsham-street, Chelmsford.

The operation of the magnetic separator described in this specification is as follows. The material to be treated is discharged from the hopper A on to the dome B by means of which it is dispersed over the face of the plate C. The particles of iron or steel contained in the material are retained by magnetic attraction of the pole edges, while the non-magnetic material is thrown outwardly into the vessel D, from which it may be

Nº349,550



removed in any convenient manner, such as by lifting the vessel. The accumulations of magnetic material may subsequently be removed by momentarily reversing the current passing through the coils by means of a double-pole switch, and on the plate being demagnetised, the material will fly off into the vessel D, from which it may be removed as described. The magnetic plate C may be formed with a concave or convex upper surface to suit the different materials to be treated, the surface of the plate being provided with a number of concentric grooves filled in with a non-magnetic material E, thereby forming north and south poles at the inner and outer circumference of each of the rings of non-magnetic material.—*May 22nd*, 1931.

MISCELLANEOUS.

349,516. February 27th, 1930.—GRINDING OR PULVERISING MACHINES, Buckley and Taylor, Ltd., of Castle Iron Works, Oldham, and Tom Buckley, of the same address.

In accordance with this invention the material is treated first in a ball type mill, and when reduced to a predetermined extent is passed to a high-speed beater type mill, in which it receives its final treatment. The high-speed beater type mill is arranged at the right-hand side of the machine, and comprises beater arms A with splayed ends B, disposed in staggered relationship and extending into a channel-shaped annular renewable member C, having projecting ridges at intervals. The casing around the beaters has holes F and G, to provide the delivery to a branch H, the holes being in such relative radial positions and being controllable by the valves I, J, so that the grade of material delivered by the machine can be adjusted. The beater arms A are mounted in a central boss-like part, carried by a ball or roller bearing upon the end of a sleeve N through which the beater driving shaft extends. The end face of the boss acts in conjunction with the tubular

Nº349,516

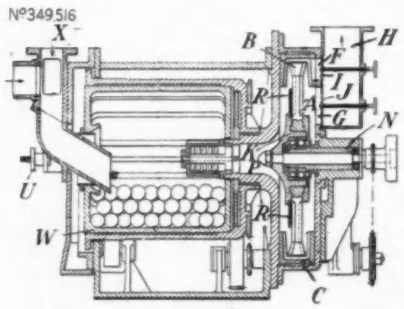


Fig.1.

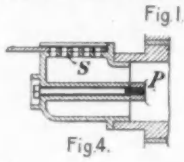


Fig.4.

part P of the intermediate frame member as a guide for the material passing to the beater type mill from the ball mill. The feed into the tubular part P from the ball mill is by way of the part shown in Fig. 4, which has a fixed grid S and a movable grid. The latter is adjusted by a wheel U. The ball mill comprises a renewable liner W with ribs or corrugations upon its internal surface, upon which the balls and material move. At one end of the mill the inlet or feed branch X of the machine is situated. The delivery from the mill takes place through the grids. The casing containing the renewable liner W runs on rollers at one end and has a bearing on the intermediate frame at the other end. The two mills are driven from a common drive, the beater shaft being rotated directly at a high speed—say, 1500 r.p.m.—by an electric motor connected to the coupling, and the ball mill casing being driven indirectly from the motor by chains at a low speed, say, 50 r.p.m.—*May 27th*, 1931.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

INDUSTRIAL WELFARE SOCIETY (INCORPORATED).—Hotel Victoria, Northumberland-avenue, W.C. 2. Luncheon. Mr. Robert R. Hyde will give an account of his recent tour of Germany and other European countries. Sir Harold Morris, K.C., of the Industrial Court, will preside. 1 p.m.

INSTITUTION OF MINING ENGINEERS.—Ninety-third general meeting at Manchester. For programme see page 690, Vol. 151.

MONDAY TO FRIDAY, JULY 13TH TO 17TH.

INSTITUTION OF MECHANICAL ENGINEERS.—Summer meeting at Cambridge. For programme see page 10.

MONDAY TO SATURDAY, JULY 13TH TO 18TH.

SOCIETY OF CHEMICAL INDUSTRY.—Jubilee Celebrations. For provisional programme see page 471, Vol. 151.

THURSDAY, JULY 16TH.

NATIONAL SMOKE ABATEMENT SOCIETY.—71, Eccleston-square, Westminster, S.W. 1. "Smoke Abatement from the Manufacturers' Point of View," by Mr. W. Prescott, of the Federation of British Industries. 3.15 p.m.

FRIDAY, JULY 17TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—South Midland District meeting at Acton. Meet at Council offices, Winchester-street, Acton, W. 3. 2.15 p.m.

SUNDAY TO SATURDAY, SEPTEMBER 6TH TO 12TH.

INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS.—Congress at Zürich.

THURSDAY TO SATURDAY, SEPTEMBER 10TH TO 26TH.

SHIPPING, ENGINEERING AND MACHINERY EXHIBITION.—Olympia, W. Daily, 11 a.m. to 9 p.m.

SATURDAY TO WEDNESDAY, SEPTEMBER 12TH TO 16TH.

INTERNATIONAL FOUNDRY CONGRESS.—Milan.

SATURDAY TO SUNDAY, SEPTEMBER 12TH TO 27TH.

INTERNATIONAL FOUNDRY EXHIBITION.—At Milan.

SUNDAY TO FRIDAY, SEPTEMBER 13TH TO 18TH.

INSTITUTE OF METALS.—Autumn meeting at Zürich.

CONTRACTS.

THE BRITISH THOMSON-HOUSTON COMPANY, Ltd., has received an order from the Royal Mail Steam Packet Company, Ltd., for part supply of Mazda lamps for the period ending May 31st, 1932.

SIR WILLIAM ARROL AND CO., Ltd., have received an order from the County of London Electric Supply Company, Ltd., for one 12-tons three-motor overhead electric travelling crane for Barking power station.

THE BRITISH THOMSON-HOUSTON COMPANY, Ltd., has received an order from the Union-Castle Mail Steamship Company, Ltd., for the supply of "Mazda" vacuum and gas-filled lamps from July 1st to December 31st, 1931.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

LAURENCE SCOTT AND ELECTROMOTORS, Ltd., of Norwich, have appointed Mr. E. Pinckston to represent them in the Birmingham area.

MAVOR AND COULSON, Ltd., of Glasgow, are closing the works for the annual fair holidays from Thursday, July 16th, to Tuesday, July 28th, 1931, at 7.55 a.m.

THE COVENTRY MACHINE TOOL WORKS, Ltd., of St. George's-road, Coventry, has appointed A. C. Wickman, Ltd., of Coventry, sole agents in Great Britain and Ireland for forging machines, hot milling machines and presses.

MAJOR JAMES CALDWELL, M. Inst. C.E., M.I.E.E., has accepted the invitation of the Quasi-Arc Company, Ltd., to join its research committee and to assist in extending the application of electric welding to welded steel construction.

MR. JOHN MILBURNE, M.I. Mech. E., of Canley Corner, Kenilworth-road, Coventry, asks us to announce that he has resigned from the position of Director of Designs to Alfred Herbert, Ltd., and has severed his connection with that company.

BURTON, GRIFFITHS AND CO., Ltd., have opened offices at Deansgate House, 274, Deansgate, Manchester. Telegraphic address, "Hibou, Manchester," and telephone number, Manchester, Blackfriars 1399. Mr. N. Greenhalgh will be the manager of this branch office.

THE ILLINOIS STOKER AND COMBUSTION COMPANY OF GREAT BRITAIN has been formed, and has offices at Atlantic House, 45–50, Holborn-viaduct, London, E.C. 1. Telegraphic address "Altonill Cent London"; telephone number, Holborn 2777, Mr. Lowden Marton is the general manager and chief engineer.

THE INDIA RUBBER, GUTTA PERCHA AND TELEGRAPH WORKS COMPANY, Ltd., asks us to announce that Mr. T. A. Cullen has been appointed manager of its Dublin branch, while the management of the Birmingham and Sheffield branches is now in the hands, respectively, of Mr. Rossiter and Mr. J. H. Hodges. Mr. G. F. Wesson has relinquished control of the Sheffield branch in order to take up an appointment as special representative for the company in the home territories. M. Selit Renny has been appointed general manager for the company in Middle Europe, and Mr. W. A. Cook, of the London branch, has now taken up his appointment as representative in the Portsmouth district.

UNIVERSITY OF BRISTOL.—A prospectus of the Faculty of Engineering, which is provided and maintained by the Society of Merchant Venturers in the Merchant Venturers' Technical College, Bristol, has just reached us. Courses of study are available at the College for persons intending to engage in civil, mechanical, electrical and automobile engineering, and particulars of these courses are given in the prospectus. The ordinances and regulations relating to degrees and diplomas in engineering subjects are also included. The prospectus can be obtained from the Registrar of the Merchant Venturers' Technical College Bristol.